Sampling and Analysis Plan for
Remedial Investigation/Feasibility Study Oversight
Gulfco Marine Maintenance Site
Freeport, Brazoria County, Texas
EPA Identification No. TXD055144539

Remedial Action Contract 2 Full Service
Contract: EP-W-06-004
Task Order: 0006-RICO-06JZ

Prepared for

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Revision: 00
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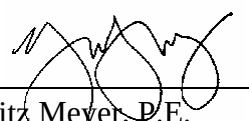

08/29/06

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1. PROJECT DESCRIPTION AND MANAGEMENT

This Sampling and Analysis Plan (SAP) is a combination Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) that has been prepared to detail sample collection procedures and analytical methods needed to collect sufficient data to support remedial investigation (RI) and feasibility study (FS) oversight activities at the Gulfco Marine Maintenance (Gulfco) Superfund site, located at 906 Marlin Avenue, Freeport, Brazoria County, Texas. By combining these two standard deliverables into a single document, the EA Engineering, Science, and Technology, Inc. (EA) team is able to streamline the planning process while ensuring that data collected are of sufficient quality for its intended use. EA has prepared this SAP in accordance with: (1) specifications provided in the U.S. Environmental Protection Agency (EPA) Statement of Work (SOW), dated 28 July 2006 (U.S. EPA 2006); (2) meetings between EPA and EA; and (3) the approved EA Work Plan (EA 2006a).

This SAP was prepared in accordance with EA's Quality Management Plan (EA 2005a) and meets requirements set forth in *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5* (U.S. EPA 2001) and *EPA Guidance for Quality Assurance Project Plans, QA/G-5* (U.S. EPA 2002).

This SAP describes procedures to assure that the project-specific data quality objectives (DQOs) are met, and that the quality of data (represented by precision, accuracy, completeness, comparability, representativeness, and sensitivity) is known and documented. The SAP presents the project description, project organization and responsibilities, and quality assurance (QA) objectives associated with the sampling and analytical services to be provided in support of RI/FS oversight activities at the Gulfco site. Table 1 demonstrates how this SAP complies with all elements of a QAPP currently required by EPA guidance (U.S. EPA 2001, 2002).

The overall QA objectives are as follows:

- Attain quality control (QC) requirements for analyses specified in this SAP
- Obtain data of known quality for the potentially responsible party's (PRP's) assessment of nature and extent of contamination and human health and ecological risks
- Document performance of the PRP's quality program including performance of the work and any required changes to work at the site.

The EPA Region 6 Task Order Monitor (TOM), Mr. Gary Miller, is responsible for the oversight of RI/FS activities conducted by the PRP and their consultant, Pastor, Behling &Wheeler, LLC (PBW). EA and its team subcontractors, Daniel B. Stephens and Associates, Inc. (DBS&A) and URS Corporation (URS), will perform all tasks under this Task Order in accordance with this SAP. The EA Project Manager, Mr. Luis Vega, is responsible for implementing all activities required by this Task Order. Figure 1 presents the proposed project organization for this Task Order.

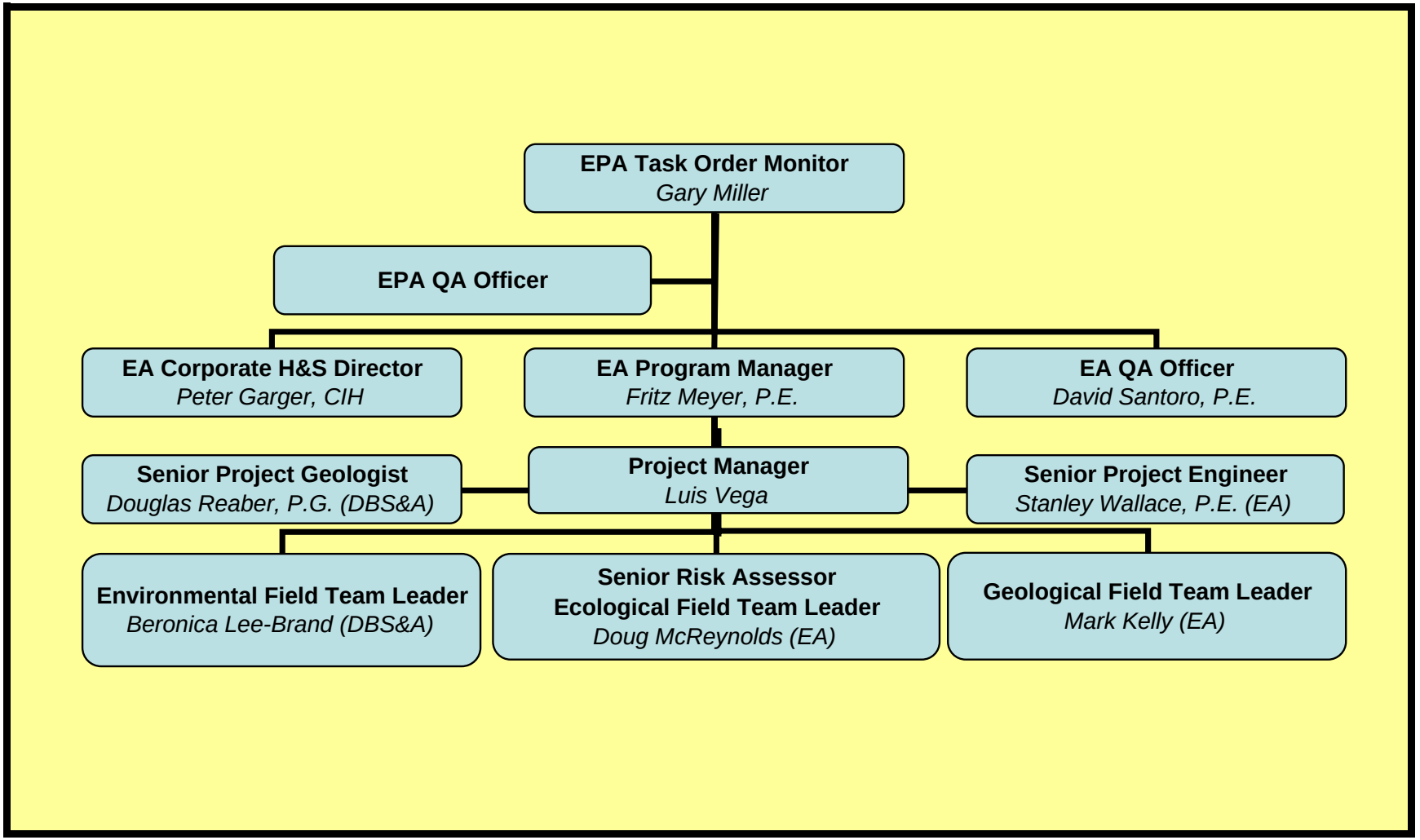

Figure 1. Project Organization.

TABLE 1 ELEMENTS OF U.S. ENVIRONMENTAL PROTECTION AGENCY QA/R-5 IN RELATION TO THIS SAMPLING AND ANALYSIS PLAN

EPA QA/R-5 Quality Assurance Project Plan Element		EA SAP	
A1	Title and Approval Sheet	Title and Approval Sheet	
A2	Table of Contents	Table of Contents	
A3	Distribution List	Distribution List	
A4	Project/Task Organization	1.0	Project Description and Management
A5	Problem Definition/Background	1.1	Site Background and Problem Definition
A6	Project/Task Description	1.2	Description of Project Objectives and Tasks
A7	Quality Objectives and Criteria	1.3	Quality Objectives and Criteria
A8	Special Training/Certification	1.4	Special Training Requirements and Certification
A9	Documents and Records	1.5	Documentation and Records
B1	Sampling Process Design	2.1	Sampling Process Design
B2	Sampling Methods	2.2	Sampling Methods
B3	Sample Handling and Custody	2.3	Sample Handling and Custody Requirements
B4	Analytical Methods	2.4	Analytical Methods Requirements
B5	Quality Control	2.5	Quality Control Requirements
B6	Instrument/Equipment Testing, Inspection, and Maintenance	2.6	Instrument and Equipment Testing, Inspection, and Maintenance Requirements
B7	Instrument/Equipment Calibration and Frequency	2.7	Instrument Calibration and Frequency
B8	Inspection/Acceptance of Supplies and Consumables	2.8	Requirements for Inspection and Acceptance of Supplies and Consumables
B9	Non-Direct Measurements	2.9	Data Acquisition Requirements (Non-Direct Measurements)
B10	Data Management	2.10	Data Management
C1	Assessment and Response Actions	3.1	Assessment and Response Actions
C2	Reports to Management	3.2	Reports to Management
D1	Data Review, Verification, and Validation	4.1	Data Review and Reduction Requirements
D2	Validation and Verification Methods	4.2	Validation and Verification Methods
D3	Reconciliation with User Requirements	4.3	Reconciliation with Data Quality Objectives

1.1 SITE BACKGROUND AND PROBLEM DEFINITION

1.1.1 Site Background

The Gulfco site is located at 906 Marlin Avenue approximately 3 mi northeast of Freeport, Texas, Brazoria County; the site coordinates are 28°58'07" north latitude and 95°17'23" west longitude (Appendix A, Figure 1). The Gulfco site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek to the east and the Old Brazos River Channel to the west. Marlin Avenue divides the site into two primary areas (Appendix A, Figure 2). The area south of Marlin Avenue drains toward the south where it enters into the Intracoastal Waterway. Drainage from the site north of Marlin Avenue is to the northeast into adjacent wetlands. The wetlands are classified as estuarine, intertidal, emergent, persistent, and irregularly flooded.

The property to the north of Marlin Avenue (the North Area) contains three closed surface impoundments and a former product storage tank area. The property south of Marlin Avenue

(the South Area) contains two barge slips connected to the Intracoastal Waterway and an aboveground storage tank farm area within a concrete berm. However, there was no berm present around the aboveground storage tank area during a 1989 inspection. The property located north, west, and east of the North Area is unused and undeveloped. Adjacent property to the east of the South Area is developed and currently used for industrial purposes, while to the west, the South Area is currently vacant and previously served as a commercial marina. A residential community and marina are located west of the former marina.

The Gulfco site operated between 1971 and approximately 1998 after which time bankruptcy was filed. The primary site operations consisted of draining, cleaning, servicing, and repairing chemical barges. The barge repair work included welding, sandblasting, and painting. Beginning in 1971, wastes from the barges were placed in the former surface impoundments, which were earthen pits located on Lot 56 in the North Area. The wastes included oils, caustics, various organic chemicals, and waste washwaters generated during barge cleaning activities. Several inspections during the 1970s reported overflow releases from the impoundments. The volume of waste materials placed in the impoundments is unknown. The impoundments were deactivated in October 1981 and closed in 1982. Impoundment closure included removal of liquids and most of the impoundment sludges. A portion of the contaminated sludge was mixed with soil and left in place, primarily in Impoundment 2 (the larger impoundment). The impoundments were capped with 3 ft of clay of unknown quality. Following closure of the impoundments, floating barges and aboveground storage tanks (ASTs) were used to store the barge washwaters.

In March 1999, sampling of the tanks in the AST area identified the presence of the following chemicals: acetone, benzene, 2-butanone, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, carbon tetrachloride, ethylbenzene; 4-methyl-2-pentanone, methylene chloride, naphthalene, styrene, tetrachloroethene, toluene, 1,1,1-trichloroethane, trichloroethene, Arochlor 1254, and xylenes.

The two primary hydrogeological units beneath the Gulfco site are the Chicot and Evangeline aquifers. The shallower Chicot aquifer is subdivided into two zones: the Lower and Upper Chicot. The Upper Chicot is comprised of interconnected sands that are found within 300 ft below ground surface (bgs). Ground water flow in the aquifer is reported to be to the southwest. A shallow, briny ground water zone exists within a few feet of the surface.

A number of chemicals have been detected in the uppermost ground water at the site, including benzene, carbon disulfide, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, ethylbenzene, methylene chloride, 4-methyl-2-pentanone, tetrachloroethene, toluene, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethene, vinyl chloride, and xylene. Some of the chemical concentrations are greater than 10 percent of their solubility in water; therefore, the presence of non-aqueous phase liquid (NAPL) is anticipated.

On 2 September 2002, EPA proposed to add the Gulfco site to the National Priorities List of Superfund sites (see Federal Register Listing FRL-7490-4, Volume 68, No. 83, Pages 23094-

23101, Proposed Rule No. 39). The Final National Priorities List listing for the site was signed on 30 May 2003.

1.1.2 Problem Definition

In accordance with the SOW, EA will perform oversight of the PRP's field activities during the RI at the Gulfco site. EA will assist EPA in assuring that the RI/FS is conducted in accordance with the PRP's approved RI/FS SAP (PBW 2006a, 2006b) and all other EPA guidance for conducting an RI/FS.

The EPA Task Order Monitor (TOM) for this Task Order is Mr. Gary Miller. He will be supported by the EA project manager and key EA staff. The PRP is responsible for implementing the RI and preparing the FS; presumably, the PRP will also be responsible for the implementation of any subsequent remedial action.

A total of 13 potential source areas (PSAs) have been identified at the site based on the site operations history, previous investigations, and existing data (Appendix A, Figure 4). Data obtained during the RI/FS will be used to define the nature and extent of the contamination and assess human health and ecological risks at the Gulfco site. This SAP was prepared to describe activities that will be performed during RI/FS oversight activities and ensure that the quality of the sampling data is known and documented.

To evaluate the performance and effectiveness of the PRP's RI/FS implementation, EA will split samples collected from surface and subsurface soil, ground water, surface water, fish tissue, and sediment samples by the PRP. An approved non-Contract Laboratory Program (CLP) laboratory will analyze samples collected by EA. The revised schedule is presented in Appendix B.

Sampling activities will be conducted in accordance with the following documents:

- EPA SOW
- PRP's SAP, including the FSP (PBW 2006b) and QAPP (PBW 2006a)
- EA's site-specific Health and Safety Plan (HSP) (EA 2006b)
- EA's site-specific SAP.

Soil (surface and subsurface), ground water, surface water, sediment, fish tissue, and biota samples will be collected to determine the nature and extent of known areas of contamination, as well as to locate other potentially contaminated areas both on and off site. Based on the distribution and concentration of contaminants detected during previous investigations at the Gulfco site, the RI sampling activities will be focused on volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, and polychlorinated biphenyls (PCBs). As part of the RI, a risk assessment will be performed by the PRP to evaluate the human health and ecological risks posed by exposure to contaminated soil, sediments, air, surface water, and ground water.

EA's field investigation activities are outlined below:

- Oversee assessment of on- and offsite surface water and sediment and collect split samples
- Oversee assessment of surface soil within each PSA and collect split samples
- Oversee initial monitoring well installation and sampling, and collect split ground water samples
- Oversee background soil sampling and hydraulic testing and collect split samples
- Oversee follow-up NAPL investigation
- Oversee residential surface soil investigation in Lots 19 and 20 and the residential properties on the west side of Snapper Lane and collect split samples
- Oversee Phase 2 and Phase 3 ground water sampling and collect split samples
- Oversee deep soil boring installation
- Oversee ecological and fish tissue sampling and collect split samples.

Data acquired during the field investigation will be evaluated to determine if the data quality are sufficient to meet established DQOs set forth in this SAP.

1.2 DESCRIPTION OF PROJECT OBJECTIVES AND TASKS

This section describes the project objectives and tasks for this SAP.

1.2.1 Project Objectives

EA's project objectives include (1) providing oversight of the PRP's sampling events at the Gulfco site and (2) collecting split samples from soil, ground water, surface water, sediment, fish tissue, and biota samples.

Based on technical direction provided by EPA during the scoping meeting, EA will subcontract non-CLP laboratory services for analysis of split samples collected by EA during RI/FS oversight activities. Based on technical direction provided by EPA in the SOW, EA anticipates fixed laboratory analysis of the following split sample quantities (subject to change):

- Soil samples (40)
- Ground water samples (8)
- Surface water samples (6)

- Sediment samples (10)
- Fish tissue samples (10)
- Biota samples (10)

Samples collected from media at the Gulfco site will be analyzed for VOCs, SVOCs, metals, pesticides, and PCBs. The specific analytical suites being evaluated for each medium are presented in Appendix C, as specified in the PRP's SAP (PBW 2006a, 2006b). Split samples will be analyzed for the same analytical suites as the PRP samples. The analytical parameters, number of samples, and sample media are discussed in greater detail in Section 2. The procedures included in this SAP are based on site information that was gathered by EA or provided by EPA. Therefore, contingency plans for sampling, sample analysis, and logistics will be developed prior to the sampling visit and, if necessary, during the sampling visit. The procedures described in the EA SAP are for guidance purposes only and may be modified before site work begins or during site work.

1.2.2 Tasks

To complete the RI/FS oversight activities, EA will perform the following tasks (with subtasks), which are outlined in the approved work plan (EA 2006a):

- Project planning and support
- Community involvement
- Field investigation/data acquisition
- Split sample analysis
- Analytical support and data validation
- Data evaluation
- Risk assessment oversight
- Oversight of treatability study/pilot testing
- PRP RI report review
- Remedial alternative screening
- Remedial alternatives evaluation
- PRP FS report review
- Post-RI/FS support
- Task order closeout

To meet project objectives, EA's tasks include (1) oversight of work efforts to confirm the PRP's adherence to the EPA-approved SAP (PBW 2006a, 2006b) during the RI and (2) collection of split samples. Confirmatory split sampling during the RI/FS is required for comparison with the PRP's data.

EA's field activities will be conducted in accordance with this SAP to ensure the proper management of split samples, including accurate chain-of-custody procedures for sample tracking, protective sample-packing techniques, and proper sample-preservation techniques.

Sample management will be conducted using the EPA-approved Forms II Lite software. EA will document the PRP's characterization and disposal of investigation-derived wastes in accordance with local, state, and federal regulations.

1.3 QUALITY OBJECTIVES AND CRITERIA

A well-defined QA/QC process is integral to the generation of analytical data of known and documented quality. The QC process includes those activities required during data collection to produce data of sufficient quality to support the decisions that will be made based on the data (e.g., decisions to be made prior to, during, and after site remedial actions) (U.S. EPA 2000a). After environmental data are collected, QA activities focus on evaluating the quality of the data in order to determine the data usability with respect to support for remedial or enforcement decisions.

1.3.1 Data Categories

In order to produce data suitable for decision-making, an appropriate analytical technique must be selected. The EPA Superfund Program has developed two descriptive categories of analytical techniques: (1) field-based techniques, and (2) fixed laboratory techniques. The type of data generated depends on the qualitative and quantitative DQOs developed for a project. Whether the resulting data are determined from either technique, all data collected must be of adequate quality for the decision-making process for which it was collected. EA will not collect split samples for field-based techniques; however, data from both techniques may be used by the PRP to support decisions made for this project. Field-based analytical data may be used by the PRP (in addition to fixed-laboratory data) to define the nature and extent of contamination and support decisions during field sampling.

According to the PRP SAP (PBW 2006a, 2006b), the types of field-based instrumentation that will be used includes a photo-ionization detector (PID) for qualitative determination of organic vapors in soil and a water quality meter to monitor ground water quality parameters in monitoring wells.

Rigorous analytical methods (such as EPA CLP methods) are used to generate analyte-specific, definitive data. The definitive quality of the data is assured by: (1) strict adherence to standard operating procedures (SOPs) and QC processes during data collection; (2) documented control and traceability of reference standards, calibrations, and instrument performance; and (3) acceptable performance of field and laboratory QC procedures within the defined limits established for these procedures.

The fixed laboratory analysis for the split samples collected during the RI will be conducted by a subcontracted non-CLP laboratory.

1.3.2 Data Quality Objectives

The DQO process is a systematic planning tool designed to ensure that the measurement data collected are of the type, quantity, and quality to best support the decisions based on these data. The DQO process is used for all data collection activities conducted under the EPA Region 6 RAC so that resources are used cost effectively. DQOs are both qualitative and quantitative statements developed through the 7-step DQO process (U.S. EPA 2000a, 2000b). The DQOs clarify the study objectives, define the conditions for data collection, determine the most appropriate data for collection, and specify tolerable limits on decision errors that will be used as the basis for establishing the quantity and quality of data that is needed. The DQOs are used to develop a scientific and resource-effective design for data collection. The 7-step iterative process used to prepare the DQOs for this project is presented in Table 2.

TABLE 2 DATA QUALITY OBJECTIVES

STEP 1: STATE THE PROBLEM
• The Gulfco site operated between 1971 and approximately 1998, after which time bankruptcy was filed. The primary site operations consisted of draining, cleaning, servicing, and repairing chemical barges. Samples collected from previous investigations revealed the soil, sediments, and groundwater at the site are contaminated with VOCs, SVOCs, and pesticides. The nature and extent of the contamination is not adequately defined.
STEP 2: IDENTIFY THE DECISIONS
• Did the PRP follow the approved RI/FS work plan? • Was the PRP's performance effective in determining the nature and extent of contamination?
STEP 3: IDENTIFY INPUTS TO THE DECISIONS
• Analytical results for split surface and subsurface soil samples • Analytical results for split ground water samples • Analytical results for split surface water and sediment samples • Analytical results for split fish tissue and biota samples • Spilt samples will be analyzed for VOCs, SVOCs, metals, organochlorine pesticides, and PCBs • Analytical data for the original sample will be obtained from the PRP for comparison with data for split samples.
STEP 4: DEFINE STUDY BOUNDARIES
• The study boundaries are defined in the PRP SAP (PBW 2006a, 2006b).
STEP 5: DEVELOP DECISION RULES
• If the data generated from the split samples is in reasonable agreement with the data collected by the PRP, then it can be assumed that the PRP is following good data collection techniques and the PRP contractor laboratory is performing adequately. Therefore, no action would be required. • If the split sample data do not agree with the data collected by the PRP, then (1) additional confirmation/verification sampling or (2) an investigation of sampling techniques and/or laboratory practices will be considered.
STEP 6: SPECIFY TOLERABLE LIMITS ON DECISION ERRORS
• A statistically-based method to evaluate and compare the data sets (EPA split samples versus PRP samples) will be used to determine whether there is good agreement between the data sets. The specific statistical method will be identified and discussed with EPA. Site-specific sampling decisions are identified in the PRP's SAP (PBW 2006a, 2006b) and are based on historical data.
STEP 7: OPTIMIZE THE SAMPLING DESIGN
• The PRP will determine the sample locations for all media based on knowledge of historical operations.

The PRP DQOs are presented in the PRP SAP (PBW 2006a, 2006b).

1.3.3 Quality Assurance Objectives for Measurement Data

To meet DQOs, it is important that procedures be developed and implemented to maintain the quality and integrity of the data generated in the field and in the laboratory. The level of QC effort and the QA objectives for the data quality indicators of sensitivity, accuracy, precision, completeness, representativeness, and comparability of data are discussed in this section. Table 3 presents the acceptance criteria for definitive onsite and offsite laboratory data for chemical analyses of investigation samples only (excluding field-based analyses).

TABLE 3 QUALITY ASSURANCE INDICATOR CRITERIA

Indicator Parameter	Analytical Parameter	QC Sample	Acceptance Criteria for Laboratory Analysis
Accuracy (percent recovery)	VOCs, SVOCs, pesticides, PCBs	MS, MSD Blanks	50 to 150 percent recovery Less than CRQL
	Metals	MS LCS Blanks	75 to 125 percent recovery 80 to 120 percent recovery Less than CRDL
Precision (RPD)	VOCs, SVOCs, pesticides, PCBs	MS, MSD Field duplicates	30 percent RPD 50 percent RPD
	Metals	MS, MD Field duplicates	20 percent RPD (aqueous) 35 percent RPD (solid) 50 percent RPD
Sensitivity (quantitation limits)	All analytical tests	MS, MD, MSD Field duplicates	Not applicable
Completeness	The objective for data completeness is 90 percent.		
Representativeness	The sampling network analytical methods for this site are designed to provide data that are representative of site conditions.		
Comparability	The use of standard published sampling and analytical methods, and the use of QC samples, will ensure data of known quality. These data can be compared to any other data of known quality.		

NOTE: CRDL = Contract-required detection limit
CRQL = Contract-required quantitation limit
LCS = Laboratory control sample
LCSD = Laboratory control sample duplicate
MD = Matrix duplicate
MS = Matrix spike
MSD = Matrix spike duplicate
RPD = Relative percent difference.

Appendix D presents the acceptance criteria prescribed in the PRP's EPA-approved SAP (PBW 2006a, 2006b) for definitive onsite and offsite laboratory data for chemical analyses of investigation samples only (excluding field-based analyses).

1.3.3.1 Sensitivity

The QA objective for sensitivity is expressed in the form of the method detection limit (MDL) or quantitation limit for the analytical method selected (U.S. EPA 2002). The required analyte quantitation limits are based on the method-specified practical quantitation limits (PQL). PQLs reflect the influences of the sample matrix on method sensitivity and are typically higher than

MDLs. The required PQLs for investigation sample analysis are presented in Appendix D, as prescribed in the PRP's EPA-approved SAP (PBW 2006a, 2006b).

1.3.3.2 Accuracy and Precision

Accuracy is the degree of agreement between an observed value and an accepted reference value. A program of sample spiking will be conducted to evaluate laboratory accuracy. This program includes analysis of the MS and MSD samples, laboratory control samples (LCS) or blank spikes, surrogate standards, and method blanks. MS and MSD samples will be prepared and analyzed at a frequency of 5 percent. LCS or blank spikes are also analyzed at a frequency of 5 percent. Surrogate standards, where available, are added to every sample analyzed for organic constituents. The results of the spiked samples are used to calculate the percent recovery for evaluating accuracy.

$$\text{Percent Recovery} = \frac{S - C}{T} \times 100\%$$

where

S = Measured spike sample concentration
C = Sample concentration
T = True or actual concentration of the spike.

Precision is the degree of mutual agreement between individual measurements of the same property under similar conditions. Usually, combined field and laboratory precision is evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as a relative percent difference (RPD).

RPD is calculated as follows:

$$\text{RPD} = \frac{|A - B|}{(A + B)/2} \times 100\%$$

where

A = First duplicate concentration
B = Second duplicate concentration.

Field sampling precision is evaluated by analyzing field duplicate samples. Precision for laboratory analyses will be measured by collecting and analyzing the types of samples discussed in Section 2 and evaluating the results against the criteria listed there.

1.3.3.3 Completeness, Representativeness, and Comparability

Completeness is measured by comparing the amount of valid data obtained to the total number of measurements needed to achieve a specified level of confidence in decision-making. After analytical testing, the percent completeness will be calculated (U.S. EPA 2000c). The completeness objective for field and laboratory data is 90 percent.

Representativeness expresses the degree to which data accurately and precisely represents (1) a characteristic of a population, (2) parameter variations at a sampling point, (3) a process condition, or (4) an environmental condition. Representativeness is a qualitative parameter that depends on the proper design of the sampling program and proper laboratory protocol. Each sample collected from the site is expected to be representative of the population or environmental condition from which it was collected. During development of the sampling network, the following were considered: (1) past waste disposal practices, (2) existing analytical data, (3) current and former onsite physical setting and processes, and (4) construction requirements. Representativeness will be satisfied by: (1) ensuring that this project-specific SAP and PRP SAP (PBW 2006a; 2006b) are followed; (2) ensuring that samples are collected in accordance with the appropriate PRP standard operating procedures (SOPs) (Appendix E), or ensuring that proper sampling techniques are used when PRP SOPs are not available; (3) following proper analytical procedures; and (4) ensuring that required holding times are not exceeded in the laboratory.

Comparability expresses the confidence with which one portion or set of data can be compared to another. Generally, comparability will be attained by achieving the QA objectives, presented in this SAP, for sensitivity, accuracy, precision, completeness, and representativeness. Comparability of data will also be attained by following field and laboratory procedures consistently for individual sites. EPA-approved procedures will be used to the maximum extent possible. EPA-approved laboratory methods will be used to increase the comparability of laboratory analytical data.

1.4 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATION

This section outlines the training and certification required to complete the activities described in this SAP. The following sections describe the requirements for the EA team and subcontractor personnel working onsite.

1.4.1 Safety and Health Training

EA team personnel who work at hazardous waste project sites are required to meet the Occupational Safety and Health Administration (OSHA) training requirements defined in 29 Code of Federal Regulations (CFR) 1910.120(e). These requirements include: (1) 40 hours of formal offsite instruction; (2) a minimum of 3 days of actual onsite field experience under the supervision of a trained and experienced field supervisor; and (3) 8 hours of annual refresher training. Field personnel who directly supervise employees engaged in hazardous waste operations also receive at least 8 additional hours of specialized supervisor training. At least one member of the field team will maintain current certification in first aid and cardiopulmonary resuscitation.

Copies of the field team's safety and health training records, including course completion certifications for the initial and refresher safety and health training, specialized supervisor training, and first aid and cardiopulmonary resuscitation training, are maintained in project files. Before work begins at a specific hazardous waste project site, EA personnel are required to undergo site-specific training that thoroughly covers the following areas:

- Names of personnel and alternates responsible for safety and health at a hazardous waste project site
- Safety and health hazards present onsite
- Selection of the appropriate personal protective equipment
- Correct use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment onsite
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazardous substances.

For more safety and health details, see EA's site-specific HSP (EA 2006b).

1.4.2 Subcontractor Training

EA does not anticipate any onsite subcontractor support during field oversight and split sampling activities. The PRP will be responsible for ensuring that any subcontractors who work onsite can certify that their employees have been trained for work on hazardous waste project sites, as defined by OSHA in 29 CFR 1910.120(e).

EA will attend any onsite safety briefings and orientation conducted by the PRP and sign the PRP's Safety Meeting Sign-Off Sheet before conducting work onsite, as required by the PRP HSP (PBW 2005b).

1.5 DOCUMENTATION AND RECORDS

This section describes the data reporting requirements for EA field personnel and laboratories (e.g., EPA CLP laboratories, EPA Region 6 laboratory, or subcontract laboratories) that submit field and laboratory measurement data under the EPA Region 6 RAC 2 program.

1.5.1 Field Documentation

EA field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities and will follow Field Technical Procedures and Guidelines, SOP 1.3 (Appendix F). The logbook will list the contract name and number; site name; and names of subcontractors, service client, and Project Manager. At a minimum, the following information will be recorded in the field logbook:

- Name and affiliation of all onsite personnel or visitors
- Weather conditions during the field activity

- Summary of daily activities and significant events
- Notes of conversations with coordinating officials
- References to other field logbooks or forms that contain specific information
- Discussions of problems encountered and their resolution
- Discussions of deviations from the SAP or other governing documents
- Description of all photographs taken.

1.5.2 Laboratory Documentation

EA will require fixed offsite non-CLP laboratories to prepare and submit data packages in accordance with the EPA CLP protocols (U.S. EPA 1999, 2005a, 2005b) for hardcopy and electronic data deliverable format of VOC, SVOC, pesticide, metal, and PCB data. Data packages will include all applicable documentation for independent validation of data and verification of the DQOs. The following documentation will be required for full data validation, if applicable:

- Case narratives, which will describe all QC non-conformances that are encountered during the analysis of samples in addition to any corrective actions that are taken

  — Statement of samples received
  — Description of any deviations from the specified analytical method
  — Explanations of data qualifiers that are applied to the data
  — Any other significant problems that were encountered during analysis

- Tables that cross-reference field and laboratory sample numbers

- Chain-of-custody forms, which pertain to each sample delivery group or sample batch that is analyzed

- Laboratory reports, which must show traceability to the sample analyzed and must contain specified information

  — Project identification

  — Field sample number

  — Laboratory sample number

  — Sample matrix description

  — Dates and times of sample collection, receipt at the laboratory, preparation, and analysis

  — Description of analytical method and reference citation

  - Results of individual parameters, with concentration units, including second column results, second detector results, and other confirmatory results, where appropriate
  - Quantitation limits achieved
  - Dilution or concentration factors.

- Data summary forms and QC summary forms showing analytical results, if applicable
  - Samples
  - Surrogates
  - Blanks
  - Field QC samples
  - LCS
  - Initial and continuing calibrations
  - Other QC samples

- Laboratory control charts
  - Raw data
  - Instrument printouts
  - Laboratory bench sheets for preparation of samples

- Method detection limit study results.

EA's Project Manager, in cooperation with the QA Officer, will define site-specific requirements for data reporting. Requests for analytical services (discussed in Section 2.4) clearly define these requirements, the turnaround time for receipt of the data deliverables specified, and any requirements for retaining samples and laboratory records. Laboratory QA Managers are responsible for ensuring that all laboratory data reporting requirements in the SAP are met.

2. DATA GENERATION AND ACQUISITION

This section describes the design and details for the planned split sampling events. Data evaluation procedures are discussed in Section 4.3. Appendix E presents the SOPs that will be implemented by the PRP during this field program. EA will conduct oversight of PRP field activities to ensure that they adhere to these SOPs and the EPA-approved SAP (PBW 2006a, 2006b), or document and justify any deviations.

2.1 SAMPLING PROCESS DESIGN

For the activities associated with this Task Order and SAP, main elements of the sampling design include the numbers and types of samples to be collected, sampling locations, sampling frequencies, and sample matrices. The EPA TOM has established the number of split samples that will be collected, as well as the media types. As directed by the EPA TOM, EA will modify this SAP. At EPA's request, this SAP will be made available to regional, state, and local stakeholders.

The following media will be sampled during the RI/FS at the Gulfco site:

- Soil
- Ground water
- Surface water
- Sediment
- Fish tissue/biota

2.1.1 Collection of Soil Samples

EA will provide oversight during the installation of soil borings and the collection of surface and subsurface soil samples by the PRP. The soil will be assessed in order to visually delineate the nature and extent of the contamination and to evaluate the underlying soil conditions through sample collection and analysis. Table 4 describes the required sample volume, containers, preservatives, and holding times for split sample analyses.

TABLE 4 ANALYTICAL PROGRAM AND METHODS

Parameter	Method [a]	Volume and Container	Preservatives	Holding Time [b]
Soil/Sediment				
VOCs (soil)	SW-846 Methods 5035/8260B	Three 5-gram EnCore samplers One 4-ounce glass jar with Teflon-lined cap (moisture content)	Store at 4±2°C	48 hours
VOCs (sediment)	SW-846 Method 8260B	Two 4-ounce glass jars with Teflon-lined cap (moisture content)	Store at 4±2°C	14 days
SVOCs	SW-846 Method 8270C	One 8-ounce glass jar with Teflon-lined cap	Store at 4±2°C	14 days
Metals	SW-846 Method 6010B/7471A	One 8-ounce glass jar with Teflon-lined cap	Store at 4±2°C	28 days
Organochlorine pesticides	SW-846 Method 8081A	One 8-ounce glass jar with Teflon-lined cap	Store at 4±2°C	14 days
PCBs	SW-846 Method 8082	One 8-ounce glass jar with Teflon-lined cap	Store at 4±2°C	14 days
Ground Water/Surface Water				
VOCs	SW-846 Method 8260B	Three 40-milliliter glass vials with Teflon-lined caps	Hydrochloric acid to pH < 2; Store at 4±2°C	14 days

Parameter	Method [a]	Volume and Container	Preservatives	Holding Time [b]
Ground Water/Surface Water (continued)				
SVOCs	SW-846 Method 8270C	Two 1-liter amber glass bottles with Teflon-lined caps	Store at 4±2°C	14 days
Metals	SW-846 Method 6010B/7470A	One 1-liter polyethylene bottle with Teflon-lined cap	Nitric acid to pH < 2; Store at 4±2°C	28 days
Organochlorine pesticides	SW-846 Method 8081A	Two 1-liter amber glass bottles with Teflon-lined caps	Store at 4±2°C	14 days
PCBs		One 1-liter amber glass bottle with Teflon-lined cap	Store at 4±2°C	14 days

(a) Unless otherwise specified, analytical method is from SW-846 (U.S. EPA 1996).
(b) Holding time is measured from the time of sample collection to the time of sample extraction and analysis.

The PRP's data collection summary for soil samples is presented in Tables 1 and 2 of the PRP FSP (PBW 2006b). The proposed surface soil sampling and boring locations are presented in Appendix A (PRP Figures 5, 6, and 9). The PRP's soil analytical parameters are presented in Appendix C.

During the soil assessment activities, EA will visually inspect the soils for evidence or contamination. Observations and sketches of the boring locations will be included in the EA field log book. The PRP will screen the soils in the field using a PID. Appendix E presents the PRP SOP(s) associated with soil sample collection.

EA will collect approximately 40 split samples from the PRP's soil investigation samples. Soil split samples will be analyzed for VOCs, SVOCs, organochlorine pesticides, PCBs, and total metals. The split samples will be submitted to an offsite laboratory for analysis, and will be delivered to the subcontracted laboratory via overnight courier or picked up by the laboratory onsite. EPA may direct EA to submit split samples for additional analyses listed in Appendix C that are not listed in Table 4.

2.1.2 Collection of Ground Water Samples

The PRP will collect ground water samples from 17 permanent monitoring wells and eight temporary piezometers, which will be installed as part of the RI/FS. The ground water samples will be collected in order to determine the lateral and vertical extent of the NAPL and dissolved phase ground water contaminants. The proposed well locations are presented in Appendix A (PRP Figures 5 and 6) and discussed in greater detail in the PRP FSP (PBW 2006b). The wells will be developed and sampled by the PRP using a low-flow sampling procedures as detailed in Section 5.5 of the PRP FSP (PBW 2006b). Table 4 describes the required sample volume, containers, preservatives, and holding times for split sample analyses. The PRP's ground water analytical parameters are presented in Appendix C. Appendix E presents the PRP SOP(s) associated with ground water sample collection.

EA will obtain eight split samples from the PRP's ground water investigation samples. Split samples will be collected at the same time the investigation samples are collected by the PRP. In order to decrease the potential for chemical volatilization during the collection of VOC samples, the PRP will immediately collect the split sample for VOC analysis following collection of the corresponding investigation sample. This procedure will then be repeated for the collection of the SVOC samples, etc. Ground water split samples will be analyzed for VOCs, SVOCs, organochlorine pesticides, PCBs, and total metals. The split samples will be submitted to an offsite laboratory for analysis, and will be delivered to the subcontracted laboratory via overnight courier or picked up by the laboratory onsite. EPA may direct EA to submit split samples for additional analyses listed in Appendix C that are not listed in Table 4.

2.1.3 Collection of Surface Water Samples

The PRP will collect surface water from 29 onsite and offsite locations in order to evaluate lateral extent of contaminants in surface water. The proposed surface water sample locations are presented in Appendix A (PRP Figures 5, 10, and 11) and discussed in greater detail in the PRP FSP (PBW 2006b). Table 4 describes the required sample volume, containers, preservatives, and holding times for split sample analyses. The PRP's surface water analytical parameters are presented in Appendix C. Appendix E presents the PRP SOP(s) associated with surface water sample collection.

EA will obtain six split samples from the PRP's surface water investigation samples. The surface water split samples will be analyzed for VOCs, SVOCs, organochlorine pesticides, PCBs, and total metals. The split samples will be submitted to an offsite laboratory for analysis, and will be delivered to the subcontracted laboratory via overnight courier or picked up by the laboratory onsite. EPA may direct EA to submit split samples for additional analyses listed in Appendix C that are not listed in Table 4.

2.1.4 Collection of Sediment Samples

The PRP will collect sediment samples from 62 onsite and offsite locations in order to evaluate the lateral extent of contaminants in sediments. The proposed sediment sample locations are presented in Appendix A (PRP Figures 5, 10, and 11) and discussed in greater detail in the PRP FSP (PBW 2006b). Table 4 describes the required sample volume, containers, preservatives, and holding times for split sample analyses. The PRP's proposed sediment analytical parameters are presented in Appendix C. Appendix E presents the PRP SOP(s) associated with sediment sample collection.

EA will obtain 10 split samples from the PRP's sediment investigation samples. The sediment split samples will be analyzed for VOCs, SVOCs, organochlorine pesticides, PCBs, and total metals. The split samples will be submitted to an offsite laboratory for analysis, and will be delivered to the subcontracted laboratory via overnight courier or picked up by the laboratory onsite. EPA may direct EA to submit split samples for additional analyses listed in Appendix C that are not listed in Table 4.

2.1.5 Collection of Fish Tissue and Biota Samples

The PRP will collect fish tissue and biota samples based on the results from the sediment sample analysis. The tissue samples will be collected from four zones as illustrated in Appendix A (PRP Figure 10). The analytical parameters will be determined based upon the Intracoastal Waterway sediment results as discussed in the PRP FSP (PBW 2006b). Appendix E presents the PRP SOP(s) associated with fish tissue and biota sample collection.

EA will obtain 20 split samples from the PRP tissue study samples. The split samples will potentially be analyzed for VOCs, SVOCs, organochlorine pesticides, PCBs, and total metals. The split samples will be submitted to an offsite laboratory for analysis, and will be delivered to the subcontracted laboratory via overnight courier or picked up by the laboratory onsite. EPA may direct EA to submit split samples for additional analyses upon PRP determination of analytical parameters.

2.2 SAMPLING METHODS

Sampling will be conducted by the PRP during the RI. EA will split samples during PRP sampling activities. This section discusses the: (1) selection and requirements of sampling methods; (2) requirements for containers, volumes, and preservation methods; and (3) holding times, sample handling, and custody requirements. Section 2.5 discusses the requirements for collecting QC samples.

2.2.1 Sampling Methods and Equipment

Sampling methods and equipment were selected to meet project objectives. The PRP field sampling team will collect samples in accordance with SOPs presented in Appendix E, as prescribed in the PRP SAP (PBW 2006a, 2006b).

The PRP will be responsible for addressing failures in the field sampling or measurement systems and will implement corrective actions in these situations. In general, corrective actions for field sampling and measurement failures include recalibration of instruments, replacement of malfunctioning measurement instruments or sampling equipment, and repeated collection of samples or repetition of measurements.

2.2.2 Sample Container, Volume, Preservation, and Holding Time Requirements

The required sample volume, container type, preservation technique, and holding time for each analysis to be conducted for split samples is presented in Table 4. The PRP's container types, preservation techniques, and holding times are outlined in Appendix C, as prescribed in the PRP QAPP (PBW 2006a).

Required containers, preservation techniques, and holding times for field QC samples, such as field duplicates, field blanks, trip blanks, and MS/MSD samples, will be the same as for field samples.

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Each split sample collected by EA (and the original samples collected by the PRP) will be traceable from the point of collection through analysis and final disposition to ensure sample integrity. Sample integrity helps to ensure the legal defensibility of the analytical data and subsequent conclusions. Sample handling will follow CLP protocols as required in EPA's *Contract Laboratory Program Guidance for Field Samplers* (U.S. EPA 2004).

- Field chain-of-custody procedures
  - Field procedures
  - Field logbooks
- Laboratory chain-of-custody procedures

EA will use EPA's data management system known as "Forms II Lite" to generate all chain-of-custody records in the field. Applicable copies of generated Forms II Lite files will be delivered to EPA data management personnel as required by CLP protocols.

2.4 ANALYTICAL METHODS REQUIREMENTS

The source of analytical services to be provided will be determined in part by DQOs and the intended use of the resulting data. EA will use EPA-approved methods for laboratory analyses of the split samples.

EA will follow the analytical services request procedures that are outlined EA's Analytical Services Delivery Plan (EA 2005b). If an analytical system fails, the QA Officer will be notified, and corrective action will be taken. In general, corrective actions will include stopping the analysis, examining instrument performance and sample preparation information, and determining the need to re-prepare and reanalyze the samples.

2.4.1 Field Analytical Methods

Water quality parameters, including pH, temperature, specific conductivity, oxidation reduction potential, dissolved oxygen, and turbidity, will be monitored by the PRP using field-based methods during the collection of ground water samples. The PRP will also field screen soil samples for organic vapors using a PID. Appendix E presents the PRP SOPs for field analytical methods, as prescribed in the PRP SAP (PBW 2006a, 2006b). EA will not collect split samples for field-based analyses.

2.4.2 Laboratory Analytical Methods

Fixed laboratory analyses of split samples will be conducted using a subcontractor non-CLP laboratory. Table 4 outlines the anticipated laboratory analytical methods for split samples collected by EA. Appendix C lists the laboratory analytical methods for PRP samples, as

prescribed in the PRP QAPP (PBW 2006a). EPA may direct EA to submit split samples for additional analyses upon PRP determination of analytical parameters. In all cases, appropriate methods of sample preparation, cleanup, and analyses are based on specific analytical parameters of interest, sample matrices, and required detection limits.

2.5 QUALITY CONTROL REQUIREMENTS

Various field and laboratory QC samples and measurements will be used to verify that analytical data meet the QA objectives. Field QC samples and measurements will be collected to assess the influence of sampling activities and measurements on data quality. Similarly, laboratory QC samples will be used to assess how the laboratory's analytical program influences data quality. This section describes the QC samples that are to be analyzed during the investigation oversight activities for: (1) each field and laboratory environmental measurement method; and (2) each sample matrix type. Table 5 provides a summary of the types and frequency of collection of field QC samples anticipated for EA split samples.

TABLE 5 FREQUENCY OF FIELD QUALITY CONTROL SAMPLES

Field Quality Control Sample	Frequency [a]
Trip blank	1 per cooler containing aqueous samples for VOC analysis
Field blank	1 per day, if site conditions render this sample necessary
Field duplicate	1 per 10 samples
Equipment (rinsate) blank	1 per day per non-dedicated equipment type per medium; EA does not anticipating splitting PRP rinsate samples
MS/MSD [b] (organics only)	1 per 20 samples (1 per 10 for Region 6 EPA Lab)
MS/MD[b] (inorganics only)	1 per 20 samples (1 per 10 for Region 6 EPA Lab)
Temperature blank	1 per cooler

(a) The QC sample collection frequency applies to samples collected for field analysis, CLP analysis, and SW-846 method analysis (U.S. EPA 1996).
(b) MS, MSD, and MD analyses are technically not field QC samples; however, they generally require that the field personnel collect additional volumes of samples and are, therefore, included on this table for easy reference.

Table 3 summarizes the acceptance criteria for each type of QC sample. Appendix G summarizes the frequency of QC samples to be collected by the PRP at during sampling activities, as prescribed in the PRP QAPP (PBW 2006a).

2.5.1 Field Quality Control Requirements

Field QC samples will be collected and analyzed to assess the quality of data that are generated by sampling activities. These samples will include laboratory QC samples collected in the field, trip blanks, field duplicates, field blanks, equipment rinsates, MS/MSDs, MS/MDs, and temperature blanks. QC samples collected in the field for fixed-laboratory analysis of split samples are presented in Table 5.

Field duplicates are independent samples that are collected as close as possible, in space and time, to the original investigative sample. Field duplicates should be collected from a sample

location that is known or suspected to be contaminated. Field duplicates can measure the influence of sampling and field procedures on the precision of an environmental measurement and provide information on the heterogeneity of a sampling location. EA will collect field duplicates at a frequency of 1 for every 10 split samples. The PRP will collect field duplicates at a frequency of 1 for every 20 samples (Appendix G; PBW 2006a). Immediately following collection of the original sample, the field duplicates are collected using the same collection method. The sample containers will be assigned a separate identification number in the field so that the samples cannot be identified as duplicate samples (blind duplicate) by laboratory personnel performing the analysis.

Field blanks are collected to assess: (1) cross-contamination during sample collection, preservation, and shipment, as well as in the laboratory; and (2) cleanliness of the sample containers and preservatives. Field blank samples consist of sample containers filled with analytically-certified, organic-free water. One field blank sample will be collected by the PRP for each day of ground water sampling activities (Appendix G; PBW 2006a). EA may split the PRP's field blank sample, as deemed necessary. If any contaminant is present in the blank samples above the MDL, the result for associated field samples that contain the same contaminant will be qualified as potentially not detected if the concentration of the field sample is less than five times the concentration found in the blank.

Equipment rinsate blanks are collected when non-dedicated or non-disposable sampling equipment are used to collect samples and put the samples into containers. These blanks assess the cleanliness of the sampling equipment and the effectiveness of equipment decontamination. Equipment rinsate blanks are collected by pouring analytically-certified, organic-free water over the decontaminated surfaces of sampling equipment that contacts sampling media. Equipment rinsate blanks are collected after sampling equipment has been decontaminated, but before the equipment is reused for sampling. If non-dedicated or non-disposable equipment is used, equipment rinsate blanks will be collected by the PRP at a frequency of once per day (Appendix G; PBW 2006a). EA may split the PRP's equipment rinsate sample, as deemed necessary.

MS/MSD samples are laboratory QC samples that are collected for organic methods; MS/MD samples are collected for inorganic methods. For solid matrices, MS/MSD and MS/MD samples require no extra volume. For aqueous samples, MS/MSDs require double or triple the normal sample volume, depending on analytical laboratory specifications; MS/MDs require double the normal sample volume. In the laboratory, MS/MSD and MS/MD samples are split and spiked with known amounts of analytes. Analytical results for MS/MSD and MS/MD samples are used to measure the precision and accuracy of the laboratory's organic and inorganic analytical programs, respectively. Each of these QC samples will be collected and analyzed at a frequency of 1 for every 20 investigative samples (Appendix G; PBW 2006a). MS/MSD samples should be collected from a sample location that is known or suspected to be contaminated. EA will split PRP MS/MSD and MS/MD samples at a frequency not to exceed 1 for every 20 split samples.

Temperature blanks are containers of deionized or distilled water that are placed in each cooler shipped to the laboratory. Their purpose is to provide a container to test the temperature of the samples in the respective cooler upon receipt by the analytical laboratory.

2.5.2 Laboratory Quality Control Requirements

All laboratories that perform analytical work under this project must adhere to a QA program that is used to monitor and control all laboratory QC activities. Each laboratory must have a written QA manual that describes the QA program in detail. The laboratory QA Manager is responsible for ensuring that all laboratory internal QC checks are conducted in accordance with EPA methods and protocols, the laboratory's QA manual, and the requirements of this SAP.

Many of the laboratory QC procedures and requirements are described in EPA-approved analytical methods, laboratory method SOPs, and method guidance documents.

The EPA methods specify the preparation and analysis of QC samples, and may include, but are not limited to, the following types: (1) LCS, (2) method blanks, (3) MS, MSD, and MD samples, (4) surrogate spikes, and (5) standard reference materials or independent check standards. The following subsections discuss the QC checks that will be required for this project.

2.5.2.1 Laboratory Control Sample

LCS are thoroughly characterized, laboratory-generated samples that are used to monitor the laboratory's day-to-day performance of analytical methods. The results of LCS analyses are compared to well-defined laboratory control limits to determine whether the laboratory system is in control for the particular method. If the system is not in control, corrective action will be implemented. Appropriate corrective actions will include: (1) stopping the analysis, (2) examining instrument performance or sample preparation and analysis information, and (3) determining whether samples should be re-prepared or reanalyzed.

2.5.2.2 Method Blanks

Method blanks, which are also known as preparation blanks, are analyzed to assess the level of background interference or contamination in the analytical system and the level that may lead to elevated concentration levels or false-positive data. Method blanks will be required for all laboratory analyses and will be prepared and analyzed at a frequency of one method blank per every 20 samples or one method blank per batch, if the batches consist of fewer than 20 samples. A method blank consists of reagents that are specific to the analytical method and are carried through every aspect of the analytical procedure, including sample preparation, cleanup, and analysis. The results of the method blank analysis will be evaluated in conjunction with other QC information to determine the acceptability of the data generated for that batch of samples. Ideally, the concentration of a target analyte in the method blank will be below the reporting limit for that analyte. For some common laboratory contaminants, a higher concentration may be allowed.

If the method blank for any analysis is beyond control limits, the source of contamination must be investigated, and appropriate corrective action must be taken and documented. This investigation includes an evaluation of the data to determine the extent of the contamination and

its effect on sampling results. If a method blank is within control limits but analysis indicates a concentration of analytes that is above the reporting limit, an investigation should be conducted to determine whether any corrective action could eliminate an ongoing source of target analytes.

For organic and inorganic analyses, the concentration of target analytes in the method blank must be below the reporting limit for that analyte for the blank to be considered acceptable. An exception may be made for common laboratory contaminants (such as methylene chloride, acetone, 2-butanone, and phthalate esters) that may be present in the blank at up to five times the reporting limit. These compounds are frequently detected at low levels in method blanks from materials that are used to collect, prepare, and analyze samples for organic parameters.

2.5.2.3 Matrix Spikes and Matrix Spike Duplicates

MS and MSD are aliquots of an environmental sample to which known concentrations of target analytes and compounds have been added. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis. If there are many target analytes, they will be divided into 2-3 spike standard solutions. Each spike standard solution will be used alternately. The MS, in addition to an unspiked aliquot, will be taken through the entire analytical procedure, and the recovery of the analytes will be calculated. Results will be expressed in terms of percent recoveries and RPD. The percent recoveries of the target analytes and compounds are calculated and used to determine the effects of the matrix on the precision and accuracy of the method. The RPD between the MS and MSD results is used to evaluate method precision.

The MS/MSD is divided into three separate aliquots, two of which are spiked with known concentrations of target analytes. The two spiked aliquots, in addition to an unspiked sample aliquot, are analyzed separately, and the results are compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results will be expressed as RPD and percent recovery and compared to control limits that have been established for each analyte. If results fall outside control limits, corrective action will be performed.

2.5.2.4 Laboratory (Matrix) Duplicates

MDs, which are also called laboratory duplicates, are prepared and analyzed for inorganic analyses to assess method precision. Two aliquots of sample material are taken from the sample and processed simultaneously without adding spiking compounds. The MD and the original sample aliquot are taken through the entire analytical procedure, and the RPD of the duplicate result is calculated. Results are expressed as RPD and are compared to control limits that have been established for each analyte.

2.5.2.5 Surrogate Spikes

Surrogates are organic compounds that are similar to the analytes of interest in chemical properties but are not normally found in environmental samples. Surrogates are added to field and QC samples, before the samples are extracted, to assess the efficacy of the extraction procedure and to assess the bias that is introduced by the sample matrix. Results are reported in

terms of percent recovery. Individual analytical methods may require sample reanalysis based on surrogate criteria.

The laboratory will use surrogate recoveries mainly to assess matrix effects on sample analysis. Obvious problems with sample preparation and analysis (such as evaporation to dryness or a leaking septum) that can lead to poor surrogate spike recoveries must be eliminated before low surrogate recoveries can be attributed to matrix effects.

2.5.3 Common Data Quality Indicators

This section describes how QA objectives for precision, accuracy, completeness, and sensitivity are measured, calculated, and reported.

2.5.3.1 Precision

Precision of many analyses is assessed by comparing analytical results of MS and MSD sample pairs for organic analyses, field duplicate samples, laboratory duplicate (MD) samples, MSDs, and field replicate measurements. If precision is calculated from two measurements, it is normally measured as an RPD. If precision is calculated from three or more replicates, relative standard deviation is calculated.

2.5.3.2 Accuracy

The accuracy of many analytical methods is assessed by using the results of MS and MSD samples for organic analyses, MS samples for inorganic analyses, surrogate spike samples, LCS, standard reference materials, independent check standards, and measurements of instrument responses against zero and span gases.

For measurements in which spikes are used, percent recovery will be calculated.

2.5.3.3 Completeness

Completeness is a measure of the percentage of project-specific data that are valid. Valid data are obtained when samples are collected and analyzed in accordance with QC procedures outlined in this SAP, and when none of the QC criteria that affect data usability are exceeded.

When all data validation is completed, the percent completeness value will be calculated by dividing the number of useable results by the total number of sample results planned for this investigation.

Completeness will also be evaluated as part of the data quality assessment process (U.S. EPA 2000c). This evaluation will help determine whether any limitations are associated with the decisions to be made based on the data collected.

2.5.3.4 Sensitivity

The achievement of method detection limits depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor the instrument sensitivity to ensure data quality and to ensure that analyses meet the QA objectives that have been established for sensitivity (Section 1.3.3.1).

2.6 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

This section outlines testing, inspection, and maintenance procedures for field equipment and instruments and for laboratory instruments.

2.6.1 General Requirements

Testing, inspection, and maintenance methods and frequency will be based on: (1) type of instrument; (2) instrument's stability characteristics; (3) required accuracy, sensitivity, and precision of the instrument; (4) instrument's intended use, considering project-specific DQOs; (5) manufacturer's recommendations; and (6) other conditions that affect measurement or operational control. For most instruments, preventive maintenance is performed in accordance with procedures and schedules recommended in: (1) the instrument manufacturer's literature or operating manual, or (2) SOPs associated with particular applications of the instrument.

In some cases, testing, inspection, and maintenance procedures and schedules will differ from the manufacturer's specifications or SOPs. This can occur when a field instrument is used to make critical measurements or when the analytical methods that are associated with a laboratory instrument require more frequent testing, inspection, and maintenance.

2.6.2 Field Equipment and Instruments

EA will conduct oversight of the PRP's field activities during the RI/FS. EA will verify that the PRP maintains field equipment and instruments in accordance with the PRP's QAPP (PBW 2006a). EA does not anticipate using any field equipment or instruments on site during the field investigation. If field equipment or instruments become necessary to conduct the oversight activities, EA will maintain the field equipment as described below.

Leased field equipment and instruments will be used to conduct field oversight activities. The vendor will be responsible for thoroughly checking and calibrating field equipment and instruments before they are shipped or transported to the field. Copies of testing, inspection, and maintenance procedures will be shipped to the field with the equipment and instruments.

After the field equipment and instruments arrive in the field, they will be inspected for damage. Damaged equipment and instruments will be replaced or repaired immediately. Battery-operated equipment will be checked to ensure full operating capacity; if needed, batteries will be recharged or replaced.

Following use, field equipment will be decontaminated properly before being returned to the source. When the equipment is returned, copies of any field notes regarding equipment problems will be included so that problems are not overlooked and any necessary equipment repairs are performed.

2.6.3 Laboratory Instruments

All laboratories that analyze samples collected under the EPA Region 6 RAC 2 program must have a preventive maintenance program that addresses: (1) testing, inspection, and maintenance procedures; and (2) the maintenance schedule for each measurement system and required support activity. This program is usually documented by an SOP for each analytical instrument that is to be used. Typically, the program will be laboratory-specific; however, it should follow requirements outlined in EPA-approved guidelines. Some of the basic requirements and components of such a program are as follows:

- As a part of its QA/QC program, each laboratory will conduct a routine preventive maintenance program to minimize instrument failure and other system malfunction.

- An internal group of qualified personnel will maintain and repair instruments, equipment, tools, and gauges. Alternatively, manufacturers' representatives may provide scheduled instrument maintenance and emergency repair under a repair and maintenance contract.

- The laboratory will perform instrument maintenance on a regularly scheduled basis. The scheduled service of critical items should minimize the downtime of the measurement system. The laboratory will prepare a list of critical spare parts for each instrument. The laboratory will request the spare parts from the manufacturer and will store the parts.

- Testing, inspection, and maintenance procedures described in laboratory SOPs will be performed in accordance with manufacturer's specifications and the requirements of the specific analytical methods that are used.

- All maintenance and service must be documented in service logbooks (or the site-specific log book) to provide a history of maintenance records. A separate service logbook should be kept for each instrument; however, due to the limited scope of this project, the service records will be maintained in the site-specific field log book. All maintenance records will be traceable to the specific instrument, equipment, tool, or gauge.

- The laboratory will maintain and file records that are produced as a result of tests, inspections, or maintenance of laboratory instruments. These records will be available for review by internal and external laboratory system audits that are conducted under the EPA Region 6 RAC 2 program.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

This section describes the procedures for maintaining the accuracy of field equipment and laboratory instruments that are used for field tests and laboratory analyses. The equipment and instruments should be calibrated before each use or, when not in use, on a scheduled periodic basis.

2.7.1 Field Equipment

EA will verify that the PRP is calibrating field equipment during the RI as specified in the PRP's QAPP (PBW 2006a). EA does not anticipate using any field equipment on site during oversight activities; however, should field equipment be required to conduct oversight activities, the equipment calibration procedure described below will be followed.

Equipment will be maintained and calibrated with sufficient frequency and in such a manner that the accuracy and reproducibility of results are consistent with the manufacturer's specifications and with project-specific DQOs. Upon arrival of the field sampling and measurement equipment, EA field personnel will examine it to verify that it is in good working condition. The manufacturer's operating manual and instructions that accompany the equipment will be consulted to ensure that all calibration procedures are followed. Measuring and testing equipment may be calibrated either internally—by using in-house reference standards—or externally—by agencies, manufacturers, or commercial laboratories. Calibration records will contain a reference identifying the source of the procedure and, where feasible, the actual procedure. Each piece of measuring and testing equipment will also be accompanied by an equipment use log. The equipment use log (which may be contained within the site-specific field log book) will be kept current and may contain the following information: (1) date of use, (2) times of use, (3) operating and assisting technicians, (4) calibration status, and (5) comments.

2.7.2 Laboratory Instruments

All laboratory equipment that is used to analyze samples collected under the EPA Region 6 RAC 2 program will be calibrated on the basis of written SOPs that are maintained by the laboratory. Calibration records (including the dates and times of calibration and the names of the personnel performing the calibration) will be filed at the location at which the analytical work was performed and maintained by the laboratory personnel who performed QC activities. Subcontractor laboratories may conduct laboratory work under the EPA Region 6 RAC 2 program. The laboratory QA Manager is responsible for ensuring that all laboratory instruments are calibrated in accordance with the requirements of this SAP.

The laboratories will follow the method-specific calibration procedures and requirements for laboratory measurements. Calibration procedures and requirements will also be provided, as appropriate, for laboratory support equipment, such as balances, mercury thermometers, pH meters, and other equipment that is used to take chemical and physical measurements.

2.8 REQUIREMENTS FOR INSPECTION AND ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The EA Project Manager is responsible for identifying the types and quantities of supplies and consumables that are needed for collecting the split samples for this Task Order. The Project Manager is also responsible for determining acceptance criteria for these items. Supplies and consumables can be received at either an equipment distribution center or a site. When supplies are received, the EA field personnel will sort the supplies according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. In addition, a form will be completed describing the problem and circumstances, and noting the purchase order number of the item. Afterward, the item will be returned to the vendor for replacement or repair.

2.9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

For this project, EA anticipates acquiring data from non-direct measurements such as databases, spreadsheets, and literature files.

2.10 DATA MANAGEMENT

Data for this project will be obtained from a combination of sources, including field measurements and the subcontracted laboratories. The data-gathering process requires a coordinated effort and will be conducted by project staff members in conjunction with all potential data producers. The data will be obtained from the analytical service provider, when appropriate, in the form of an electronic data deliverable, in addition to the required hard copy analytical data package. Formal verification (or validation) of data will be conducted before associated results are presented or are used in subsequent activities.

Data tracking is essential to ensure timely, cost-effective, and high-quality results. Data tracking begins with sample chain of custody. When the analytical service provider receives custody of the samples, the provider will send a sample acknowledgment to EA. The sample acknowledgment will confirm sample receipt, condition, and required analyses. The EPA tracking software (Forms II Lite) will contain all pertinent information about each sample and can track the data at each phase of the process. The tracking software carries the data through completion of the data validation.

EA will validate 10 percent of the investigative analytical data received from subcontract laboratories (other than the EPA Region 6 Houston laboratory or CLP laboratories) to ensure that the confirmatory data are accurate and defensible, as described in Section 4 of this SAP. A partial review will be conducted on the remaining 90 percent of the data received from subcontract laboratories. All data will be evaluated for usability by EA.

As a part of the data validation process, electronic data deliverables will be reviewed against hard copy deliverables to ensure accurate transfer of data. In addition, the hard copy will be

evaluated for errors in the calculation of results. After the data validation, qualifiers can be placed on the data to indicate the usability of the data. These qualifiers will be placed into an electronic data file. Upon approval of the data set with the appropriate data qualifiers, the electronic data will be released to the Project Manager for reporting.

3. ASSESSMENT AND OVERSIGHT

This section describes the field and laboratory assessments that may be conducted during this project, the individuals responsible for conducting assessments, corrective actions that may be implemented in response to assessment results, and how quality-related issues will be reported to EA and EPA.

3.1 ASSESSMENT AND RESPONSE ACTIONS

Under the EPA Region 6 RAC 2 program, performance and system audits of field and laboratory activities may be conducted to verify that sampling and analysis are performed in accordance with the following:

- Performance and system audits
  - — Audit personnel
  - — Audit scope of work
  - — Audit frequencies
  - — Audit reports
- Corrective action
  - — Sample collection and field measurements
  - — Laboratory analyses.

Non-conforming items and activities are those that do not meet the project requirements, procurement document criteria, and approved work procedures. Non-conformance may be detected and identified by the following personnel:

- Project Personnel—During field operations, supervision of subcontractors, and field inspections
- Testing Personnel—During preparation for and performance of tests, equipment calibration, and QC activities
- QA Personnel—During the performance of audits, surveillance, and other QA activities.

Each non-conformance that affects quality will be documented by the person who identifies or originates the nonconformance. Documentation of nonconformance will include the following components:

- Description of nonconformance
- Identification of personnel who are responsible for correcting the nonconformance and, if verification is required, for verifying satisfactory resolution
- Method(s) for correcting the nonconformance (corrective action) or description of the variance granted
- Proposed schedule for completing corrective action and the corrective action taken.

Non-conformance documentation will be made available to the Project Manager, QA Manager, and subcontractor (e.g., non-CLP subcontract laboratories) management personnel, as appropriate.

The field personnel and QA personnel, as appropriate, are responsible for notifying the Project Manager and the QA Manager of the non-conformance. In addition, the Project Manager and the project staff, as appropriate, will be notified of significant non-conformances that could affect the results of the work. The Project Manager is responsible for determining whether notification of EPA is required.

The completion of corrective actions for significant non-conformances will be documented by QA personnel during future auditing activities. Any significant recurring non-conformance will be evaluated by project and QA personnel, as appropriate, to determine its cause. Appropriate changes will be instituted, under corporate or project procedures, to prevent recurrence. When such an evaluation is performed, the results will be documented.

3.2 REPORTS TO MANAGEMENT

Effective management of environmental data collection operations requires timely assessment and review of measurement activities. It is essential that open communication, interaction, and feedback be maintained among all project participants, including the: (1) EA QA Manager, Program Manager, Project Manager, technical staff, and laboratory subcontractors; and (2) EPA Region 6 TOM and QA Officer. EA prepares monthly progress reports for each Task Order that is conducted under the EPA Region 6 RAC 2 program. These reports address any QA issues that are specific to the Task Order and facilitate timely communication of such issues.

At the program level, the QA Manager prepares quarterly status reports of QA issues that are related to EA's work on the EPA Region 6 RAC 2 program. These reports are distributed to EA's president, corporate QA Manager, RAC Program Manager, and, upon request, the EPA Region 6 Project Officer. QA status reports address the following areas:

- Results of QA audits and other inspections, including any quality improvement opportunities that have been identified for further action
- Instrument, equipment, or procedural problems that affect QA
- Subcontractor performance issues
- Corrective actions
- Status of previously reported activities and continuous quality improvement initiatives
- Work planned for the next reporting period.

4. DATA VALIDATION AND USABILITY

This section describes the procedures that are planned to review, verify, and validate field and laboratory data. This section also discussed procedures for verifying that the data are sufficient to meet DQOs and measurement quality objectives for the project.

4.1 DATA REVIEW AND REDUCTION REQUIREMENTS

This section focuses on data review and reduction requirements for work conducted under the EPA Region 6 RAC 2 program. Section 4.2 addresses data validation and verification requirements. Section 4.3 addresses reconciliation with DQOs.

Data reduction and review are essential functions for preparing data that can be used effectively to support project decisions and DQOs. These functions must be performed accurately and in accordance with EPA-approved procedures and techniques. Data reduction includes all computations and data manipulations that produce the final results that are used during the investigation. Data review includes all procedures that field or laboratory personnel conduct to ensure that measurement results are correct and acceptable in accordance with the QA objectives that are stated in this SAP. Field and laboratory measurement data reduction and review procedures and requirements are specified in previously discussed field and laboratory methods, SOPs, and guidance documents.

Field personnel will record, in a field logbook and/or on the appropriate field form, all raw data from chemical and physical field measurements. The EA field staff have the primary responsibility for: (1) verifying that field measurements were made correctly, (2) confirming that sample collection and handling procedures specified in this task order-specific SAP were followed, and (3) ensuring that all field data reduction and review procedures requirements are followed. The EA field staff is also responsible for assessing preliminary data quality and for

advising the data user of any potential QA/QC problems with field data. If field data are used in a project report, data reduction methods will be fully documented in the report.

The Region 6, CLP laboratories, and/or subcontracted non-CLP laboratories will complete data reduction for chemical and physical laboratory measurements and will complete an in-house review of all laboratory analytical results. The Laboratory QA Manager will be responsible for ensuring that all laboratory data reduction and review procedures follow the requirements that are stated in this SAP. The Laboratory QA Manager will also be responsible for assessing data quality and for advising the EA QA Manager of possible QA/QC problems with laboratory data.

4.2 VALIDATION AND VERIFICATION METHODS

All data that are used to support activities under the EPA Region 6 RAC 2 program must be valid for their intended purposes. This section outlines the basic data validation procedures that will be followed for all field and laboratory measurements. The following subsections identify personnel who are responsible for data validation and the general data validation process and EPA data validation guidance that will be followed.

4.2.1 Data Validation Responsibilities

When analytical services are provided by laboratories subcontracted by EA, EA is responsible for data validation. The QA Manager has primary responsibility for coordinating EA's data validation activities. EA will conduct full validation on 10 percent of all subcontracted laboratory data for investigation samples. Partial validation will be conducted on the remaining 90 percent of all subcontracted laboratory data. Data validation and review will be completed by one or more experienced data reviewers. When data are generated by the EPA Region 6 laboratory in Houston, Texas, it will be used as received from the laboratory, with no further validation. Data from CLP laboratories are validated by EPA's Environmental Services Assistance Team.

4.2.2 Data Validation Procedures

The validity of a data set is determined by comparing the data with a predetermined set of QC limits. EA data reviewers will conduct a systematic review of the data for compliance with established QC limits (such as sensitivity, precision, and accuracy), on the basis of spike, duplicate, and blank sampling results that are provided by the laboratory. The data review will identify any out-of-control data points or omissions. EA data reviewers will evaluate laboratory data for compliance with the following information:

- Method and project-specific analytical service requests
- Holding times
- Initial and continuing calibration acceptance criteria

- Field, trip, and method blank acceptance criteria
- Surrogate recovery
- Field duplicates and MS and MSD acceptance criteria
- MD precision
- LCS accuracy
- Other laboratory QC criteria specified by the method or on the project-specific analytical service request form
- Compound identification and quantitation
- Overall assessment of data, in accordance with project-specific objectives.

EA will follow the most current EPA CLP guidelines (U.S. EPA 1999 and 2005b) for completing data validation for all applicable test methods. General procedures in the CLP guidelines will be modified, as necessary, to fit the specific analytical method that is used to produce the data. In all cases, data validation requirements will depend on: (1) DQO levels that are defined in Section 1.3, (2) reporting requirements that are defined in Section 1.5, and (3) data deliverables that are requested from the laboratory, as discussed in Section 1.5.

4.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

The main purpose of a QA system is to define a process for collecting data that are: of known quality, scientifically valid, legally defensible, and fully support any decisions that will be based on the data. To achieve this purpose, the SAP requires that DQOs be fully defined (Section 1.3). All other parts of the QA system must then be planned and implemented in a manner that is consistent with the DQOs. QA system components that follow directly from the DQOs include: (1) documentation and reporting requirements (Section 1.5), (2) sample process design and sampling methods requirements (Sections 2.1 and 2.2), (3) analytical methods and analytical service requests (Section 2.4), (4) QC requirements (Section 2.5), and (5) data reduction and validation and reporting methods (Sections 4.1 and 4.2).

After environmental data have been collected, reviewed, and validated, the data will undergo a final evaluation to determine whether the DQOs specified in this SAP have been met. EA will follow EPA's data quality assessment process to verify that the type, quality, and quantity of data that are collected are appropriate for their intended use (U.S. EPA 2000b).

The data quality assessment process involves: (1) verifying that the data have met the assumptions under which the data collection design and DQOs were developed, (2) taking appropriate corrective action if the assumptions have not been met, and (3) evaluating the extent

to which the data support the decision that must be made so that scientifically valid and meaningful conclusions can be drawn from the data. To the extent possible, EA will follow data quality assessment methods and procedures that have been outlined by EPA (2000c).

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Appendix A

Selected Figures from PRP FSP (May 2006)

TEXAS

QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

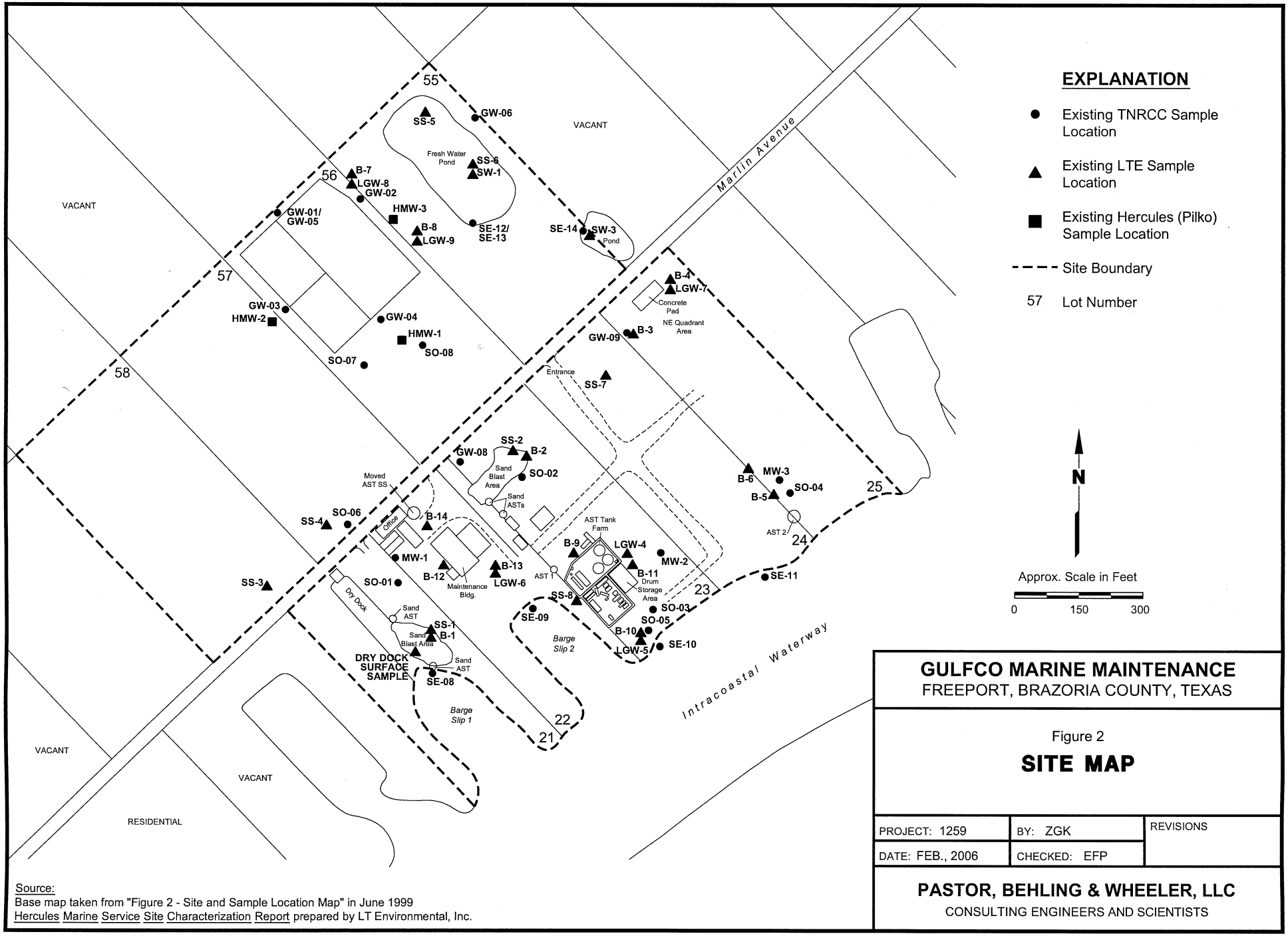
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



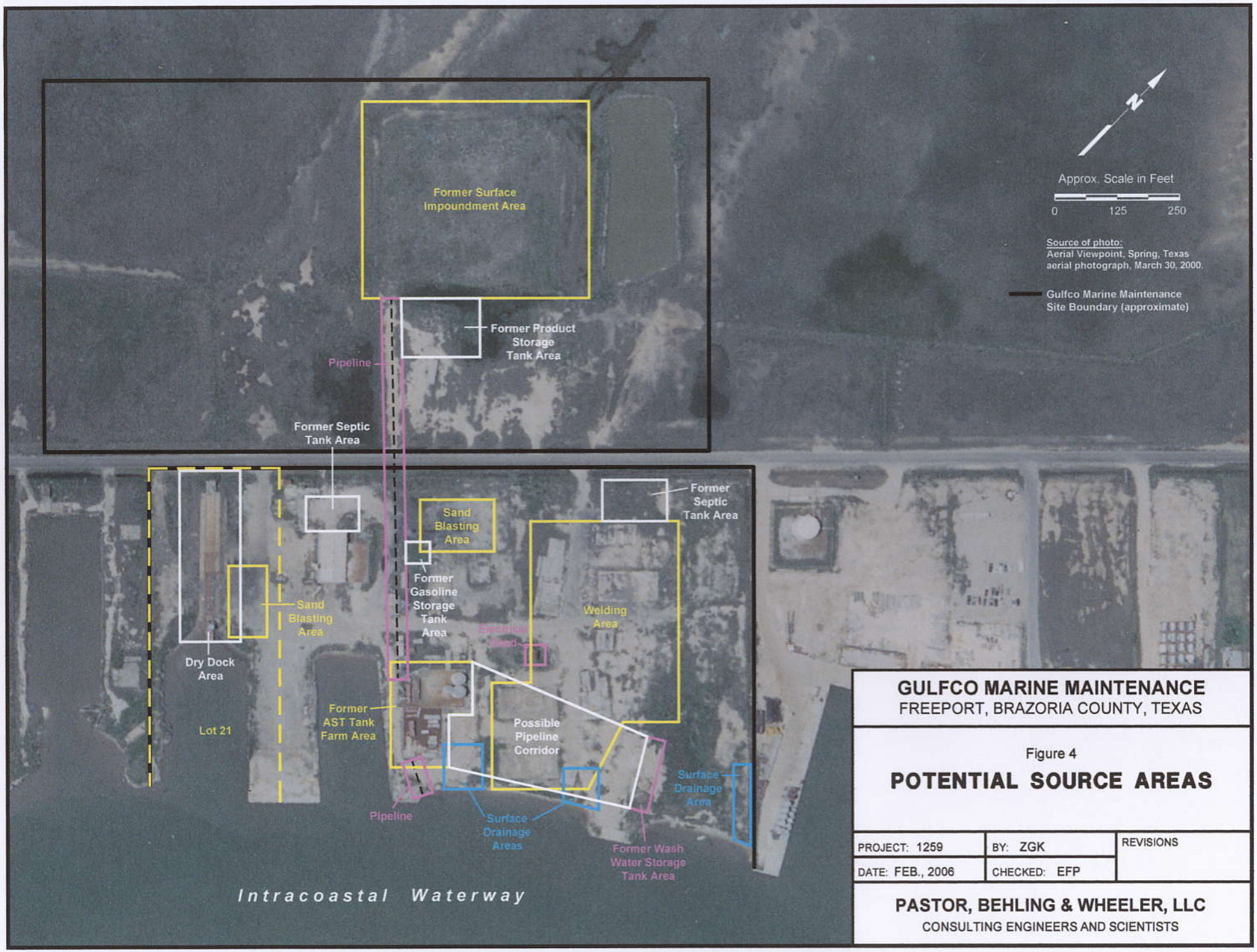
Source:
Base map taken from "Figure 2 - Site and Sample Location Map" in June 1999
Hercules Marine Service Site Characterization Report prepared by LT Environmental, Inc.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 2
SITE MAP

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



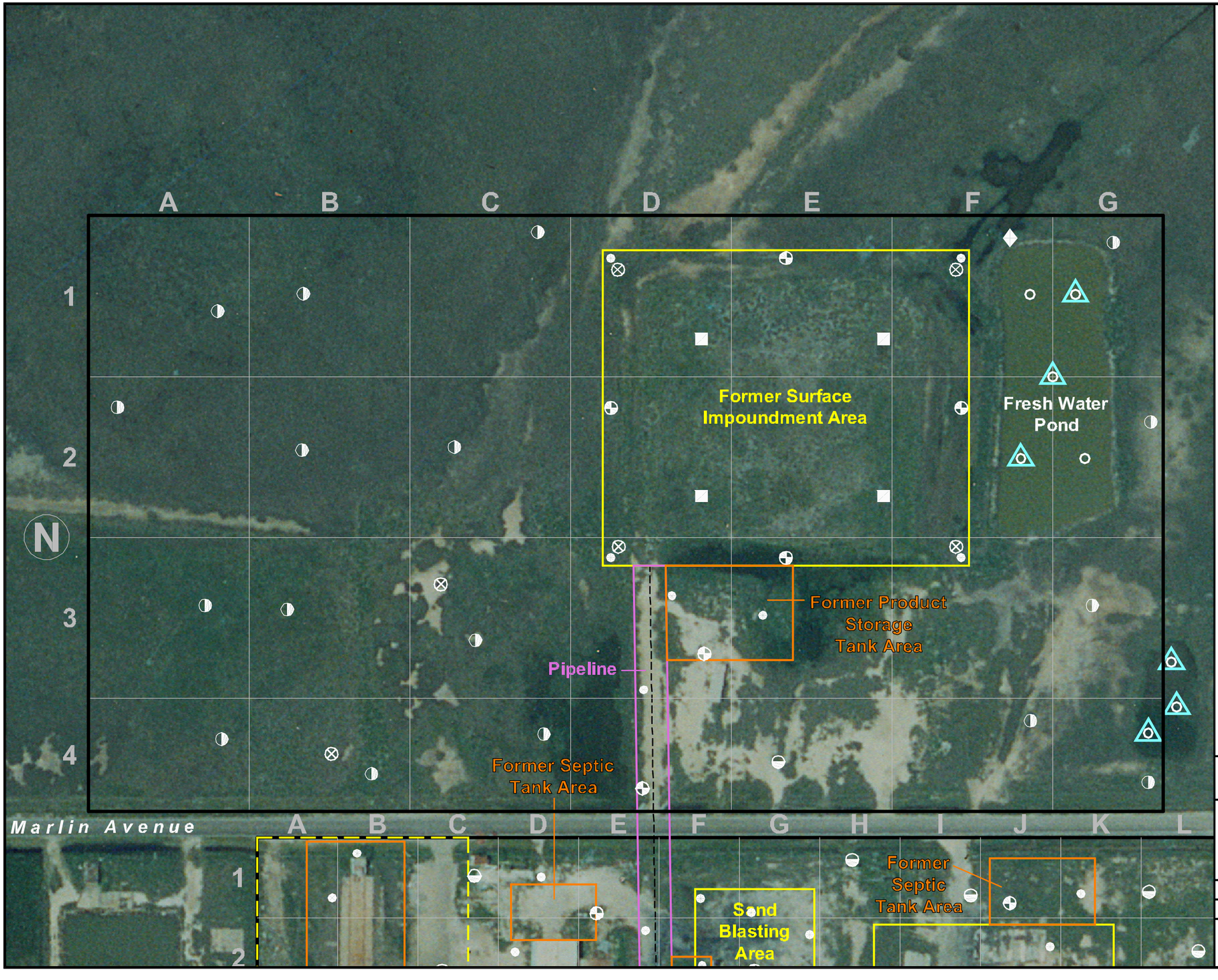
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 4

POTENTIAL SOURCE AREAS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Geotechnical Sample
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Judgmental Sediment Sample (0-6 in)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Staff Gauge
- Surface Water Sample (Fresh Water and Small Pond)

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 5

SAMPLE LOCATIONS NORTH AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Staff Gauge

N

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 6

SAMPLE LOCATIONS SOUTH AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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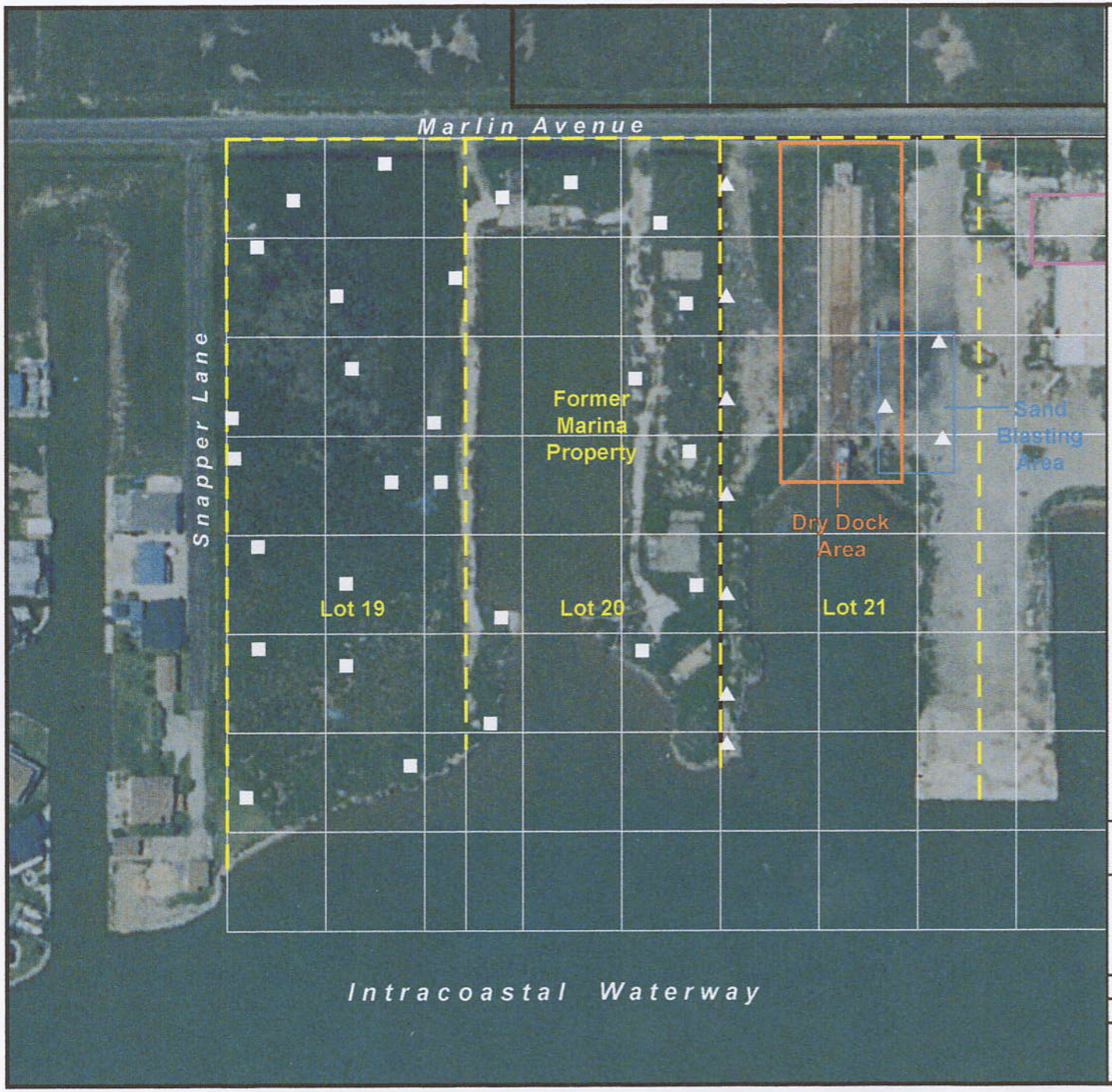

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- ▲ Lot 21 Surface Soil Sample (0-1 in)
- ■ Lot 19/20 Surface Soil Sample (0-1 in)

Notes:
Soil sample locations subject to change based on field conditions. Composite samples also to be collected from residential properties on west side of Snapper Lane. Specific locations will be determined based on building locations and thus are not shown on this figure.

N

Approx. Scale in Feet

0 75 150

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 9

RESIDENTIAL SURFACE SOIL INVESTIGATION SAMPLE LOCATIONS

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Sediment / Crab Tissue Sample Location
- Zone 1 — Surface Water / Fish Netting Station Zone

N

Approx. Scale in Feet

0 60 120

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 10

SURFACE WATER/SEDIMENT/FISH TISSUE SAMPLE LOCATIONS- INTRACOASTAL WATERWAY

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
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EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Judgmental Soil Sample (0-2 ft)
- Random Systematic Soil Sample (0-2 ft)
- Lot-21 Random Systematic and Judgmental Soil Sample (0-1 in)
- Geotechnical Sample
- Monitoring Well / Judgmental Soil Sample (0-2 ft)
- Judgmental Sediment Sample (0-6 in)
- Random Systematic Sediment Sample (0-6 in)
- Temporary Piezometer
- Surface Water Sample (Fresh Water and Small Pond)
- Off-Site Wetland Surface Water and Sediment

N

Approx. Scale in Feet

0 80 160

Source of photo: Aerial Viewpoint, Spring, Texas aerial photograph, March 30, 2000.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 11

OFF-SITE WETLAND SURFACE WATER AND SEDIMENT SAMPLE AREA

PROJECT: 1259	BY: ZGK	REVISIONS
DATE: FEB., 2006	CHECKED: EFP	

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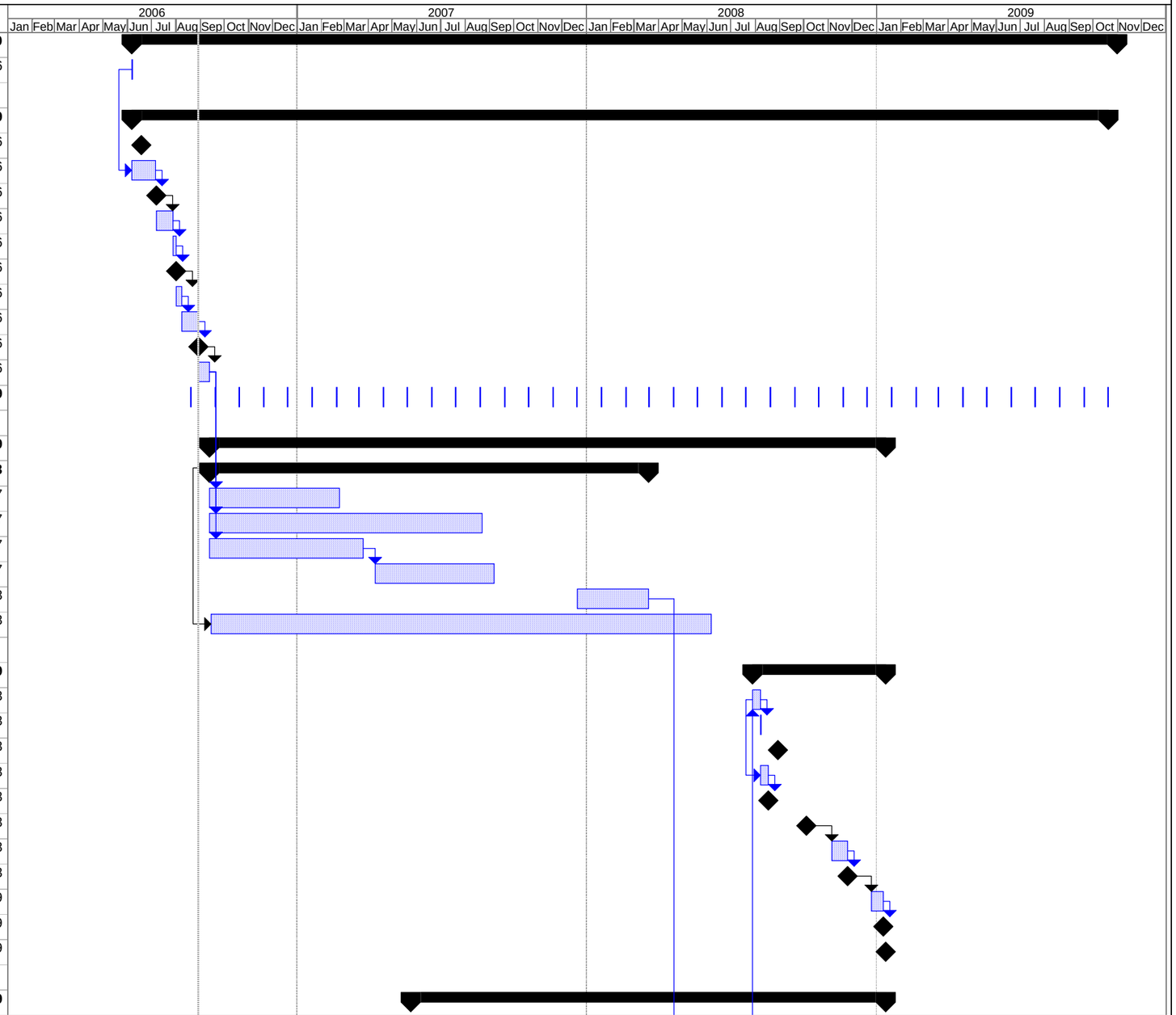
Appendix B

Revised Task Order Schedule

TASK ORDER SCHEDULE
EPA REGION 6, RAC2, Contract EP-W-06-004, Task Order 0006-RICO-06JZ, RI/FS Oversight, Gulfco Marine Maintenance Superfund Site

ID	WBS	Task Name	Start	Finish
1	**0**	**Gulfco Marine Maintenance RI/FS Oversight**	**Wed 6/7/06**	**Sat 10/31/09**
2	0	Initiate Task Order	Wed 6/7/06	Wed 6/7/06
3				
4	**1**	**Project Planning**	**Wed 6/7/06**	**Tue 10/20/09**
5	1.1	Attend Scoping Meeting	Mon 6/19/06	Mon 6/19/06
6	1.1	Prepare Work Plan	Wed 6/7/06	Thu 7/6/06
7	1.1	Submit Work Plan	Fri 7/7/06	Fri 7/7/06
8	1.1	EPA Review of Work Plan	Sat 7/8/06	Fri 7/28/06
9	1.1	Revise Work Plan (Revision 01)	Sat 7/29/06	Tue 8/1/06
10	1.1	Submit Revised Work Plan (Revision 01)	Tue 8/1/06	Tue 8/1/06
11	1.1	EPA Review/Approval of Revised Work Plan	Wed 8/2/06	Tue 8/8/06
12	1.2	Prepare SAP/HSP	Wed 8/9/06	Tue 8/29/06
13	1.2	Submit SAP/HSP	Tue 8/29/06	Tue 8/29/06
14	1.2	EPA Review/Approval of SAP/HSP	Wed 8/30/06	Tue 9/12/06
15	1.4	Submit MSR/Invoice	**Sun 8/20/06**	**Tue 10/20/09**
55				
56	**3**	**Field Investigation/Data Acquisition**	**Wed 9/13/06**	**Tue 1/13/09**
57	3.1	Conduct Field Oversight/Split Sampling	**Wed 9/13/06**	**Wed 3/19/08**
58		Soil Investigation	Wed 9/13/06	Fri 2/23/07
59		Ground Water/NAPL Investigation	Wed 9/13/06	Wed 8/22/07
60		Surface Water/Sediment Investigation	Wed 9/13/06	Sun 3/25/07
61		Fish Tissue Investigation	Tue 4/10/07	Thu 9/6/07
62		Ecological Sampling	Fri 12/21/07	Wed 3/19/08
63	3.2	Prepare Technical Oversight Reports	Fri 9/15/06	Fri 6/6/08
64				
65	**7**	**Human Health Risk Assessment (HHRA)**	**Tue 7/29/08**	**Tue 1/13/09**
66	7.1	Review Potential Chemicals of Concern (COC) Memo	Tue 7/29/08	Thu 8/7/08
67	7.1	Submit Review Comments	Fri 8/8/08	Fri 8/8/08
68	7.1	EPA Approval of Potential COC Memo	Sat 8/30/08	Sat 8/30/08
69	7.1	Review Exposure Assessment Memo (EAM)	Fri 8/8/08	Sun 8/17/08
70	7.1	Submit Review Comments	Sun 8/17/08	Sun 8/17/08
71	7.1	EPA Approval of EAM	Sun 10/5/08	Sun 10/5/08
72	7.1	Review Draft HHRA Report	Thu 11/6/08	Tue 11/25/08
73	7.1	Submit Review Comments	Tue 11/25/08	Tue 11/25/08
74	7.2	Review Final HHRA Report	Fri 12/26/08	Fri 1/9/09
75	7.2	Submit Review Comments	Fri 1/9/09	Fri 1/9/09
76	7.2	EPA Approval of Final HHRA Report	Tue 1/13/09	Tue 1/13/09
77				
78	**7**	**Ecological Risk Assessment (ERA)**	**Fri 5/25/07**	**Tue 1/13/09**



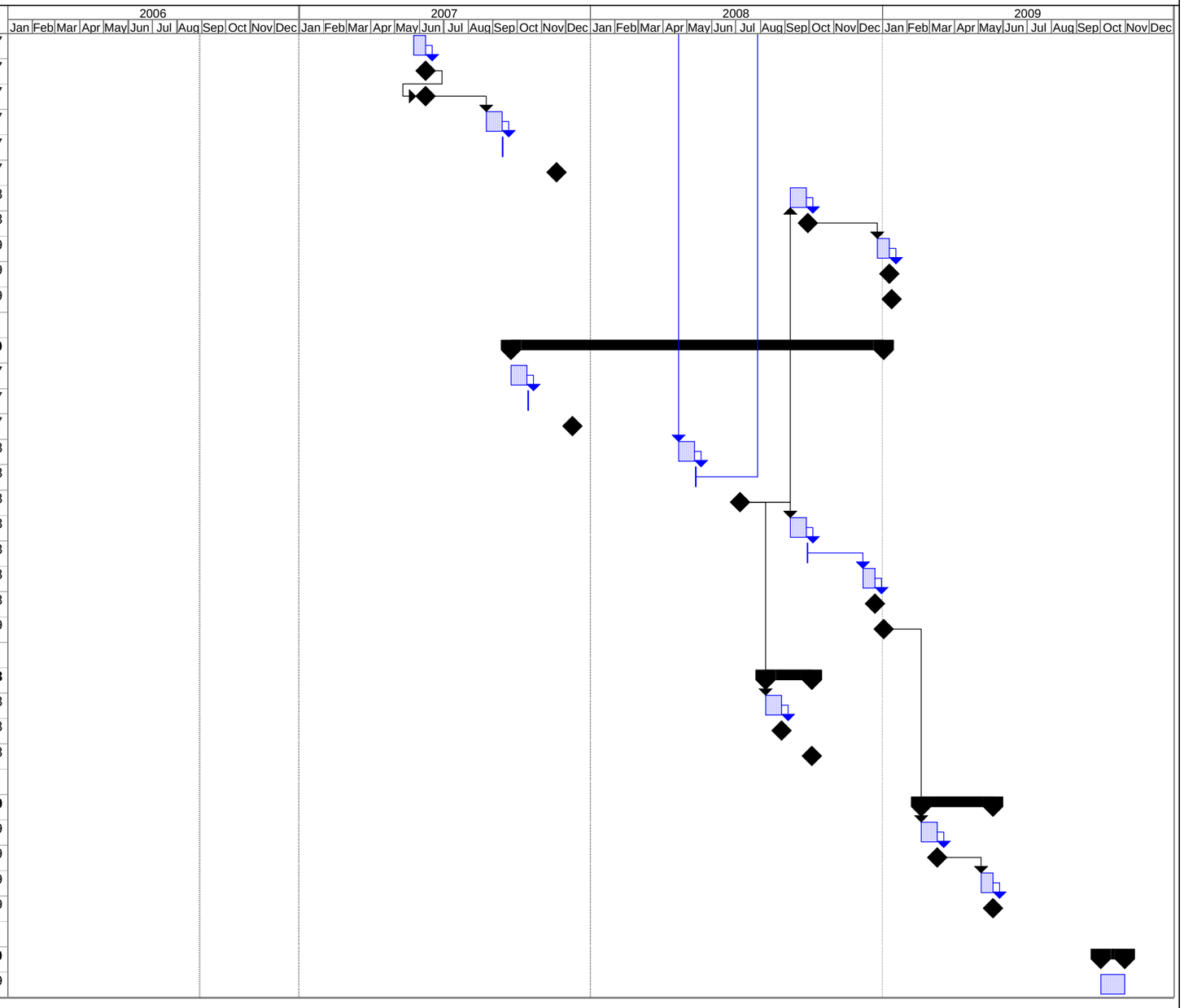
Gulfco Marine Maintenance RI/FS Oversight
August 29, 2006
Revision 02

Task | Summary | Rolled Up Progress | Project Summary
Progress | Rolled Up Task | Split | Group By Summary
Milestone | Rolled Up Milestone | External Tasks | Deadline

Note:
EA's RI/FS Oversight Task Order schedule is considered "preliminary" based on the PRP's preliminary RI/FS project schedule submitted to EPA in May 2006.

TASK ORDER SCHEDULE
EPA REGION 6, RAC2, Contract EP-W-06-004, Task Order 0006-RICO-06JZ, RI/FS Oversight, Gulfco Marine Maintenance Superfund Site

ID	WBS	Task Name	Start	Finish
79	7.2	Review Screening Level ERA (SLERA) Report	Fri 5/25/07	Fri 6/8/07
80	7.2	Submit Review Comments	Fri 6/8/07	Fri 6/8/07
81	7.2	EPA Approval of SLERA Report	Fri 6/8/07	Fri 6/8/07
82	7.2	Review Eco Problem Formulation Report (EPFR)/Work Plan	Fri 8/24/07	Wed 9/12/07
83	7.2	Submit Review Comments	Thu 9/13/07	Thu 9/13/07
84	7.2	EPA Approval of EPFR/Work Plan	Tue 11/20/07	Tue 11/20/07
85	7.2	Review Draft Baseline ERA (BERA) Report	Mon 9/8/08	Sat 9/27/08
86	7.2	Submit Review Comments	Mon 9/29/08	Mon 9/29/08
87	7.2	Review Final BERA	Fri 12/26/08	Fri 1/9/09
88	7.2	Submit Review Comments	Fri 1/9/09	Fri 1/9/09
89	7.2	EPA Approval of Final BERA	Tue 1/13/09	Tue 1/13/09
90				
91	**9**	**Remedial Investigation (RI) Report**	**Mon 9/24/07**	**Sat 1/3/09**
92	9.1	Review Nature & Extent Report	Mon 9/24/07	Sat 10/13/07
93	9.1	Submit Review Comments	Mon 10/15/07	Mon 10/15/07
94	9.1	EPA Approval of Nature & Extent Report	Mon 12/10/07	Mon 12/10/07
95	9.1	Review Preliminary Site Characterization Report (PSCR)	Mon 4/21/08	Sat 5/10/08
96	9.1	Submit Review Comments	Mon 5/12/08	Mon 5/12/08
97	9.1	EPA Approval of PSCR	Mon 7/7/08	Mon 7/7/08
98	9.1	Review Draft RI Report	Mon 9/8/08	Sat 9/27/08
99	9.1	Submit Review Comments	Mon 9/29/08	Mon 9/29/08
100	9.2	Review Final RI Report	Mon 12/8/08	Mon 12/22/08
101	9.2	Submit Review Comments	Mon 12/22/08	Mon 12/22/08
102	9.2	EPA Approval of Final RI Report	Sat 1/3/09	Sat 1/3/09
103				
104	**10**	**Remedial Alternatives Screening**	**Fri 8/8/08**	**Sun 10/5/08**
105	10.1	Review Remedial Alternatives Technical Memo (RATM)	Fri 8/8/08	Wed 8/27/08
106	10.1	Submit Review Comments	Wed 8/27/08	Wed 8/27/08
107	10.1	EPA Approval of RATM	Sun 10/5/08	Sun 10/5/08
108				
109	**12**	**Feasibility Study (FS) Report**	**Thu 2/19/09**	**Tue 5/19/09**
110	12.1	Review Draft FS Report	Thu 2/19/09	Tue 3/10/09
111	12.1	Submit Review Comments	Tue 3/10/09	Tue 3/10/09
112	12.2	Review Final FS Report	Tue 5/5/09	Tue 5/19/09
113	12.2	Submit Review Comments	Tue 5/19/09	Tue 5/19/09
114				
115	**15**	**Task Order Closeout**	**Fri 10/2/09**	**Sat 10/31/09**
116	15.5	Prepare/Submit Task Order Closeout Report	Fri 10/2/09	Sat 10/31/09



Gulfco Marine Maintenance RI/FS Oversight
August 29, 2006
Revision 02

Task | Summary | Rolled Up Progress | Project Summary
Progress | Rolled Up Task | Split | Group By Summary
Milestone | Rolled Up Milestone | External Tasks | Deadline

Note:
EA's RI/FS Oversight Task Order schedule is considered "preliminary" based on the PRP's preliminary RI/FS project schedule submitted to EPA in May 2006.

Appendix C

Analytical Methods and Required Sample Containers, Preservatives, and Holding Times, As Prescribed in PRP QAPP (March 2006)

TABLE A-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: SOIL

Intended Use: Investigate possibility of additional Potential Source Areas
Nature and extent of contamination
Quantitative risk assessment - human health and ecological

QC Level: Level III with Level IV for 10% of the sample sets (selected by RI Manager with consideration given to sample results, location and matrix)

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Metals	PBW-SOP-5	ICP-AES	SW846 3050B	SW846 6010B
Chromium VI	PBW-SOP-5	Colorimetric	SW846 3060A	SW846 7196A
Mercury	PBW-SOP-5	Cold Vapor AA	SW846 7471A	SW846 7471A
Organochlorine Pesticides	PBW-SOP-5	GC	SW846 3550B cleanup (e.g., 3620B) as needed	SW846 8081A
PCBs	PBW-SOP-5	GC	SW846 3550B cleanup (e.g., 3665A) as needed	SW846 8082
VOCs	PBW-SOP-5	GC/MS	SW846 5035	SW846 8260B
SVOCs	PBW-SOP-5	GC/MS	SW846 3550B cleanup (e.g., 3640A) as needed	SW846 8270C
Moisture Content	PBW-SOP-5	Gravimetric	NA	SM 2540G
Total Organic Carbon	PBW-SOP-5	NA	NA	SW846 415.1/9060
Soil Bulk Density	PBW-SOP-5	NA	NA	ASTM D2937
pH	PBW-SOP-5	NA	NA	SW-846 9045
Geotechnical Analyses[(1)]				
Percent Passing No. 200 Sieve Analysis	PBW-SOP-5	NA	NA	ASTM D1140
Atterburg Limits	PBW-SOP-5	NA	NA	ASTM 4318
Vertical Hydraulic Conductivity	PBW-SOP-5	NA	NA	COE EM-1110-2-1906

NOTES:
1. Analyses only performed on Former Impoundment Cap samples.

TABLE A-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: SOIL

Laboratory Parameters	Container	Preservation	Holding Time
Chemical Analyses			
Metals	P, G	Cool to 4 C	6 months
Chromium VI	P, G	Cool to 4 C	30 days (preparation) 4 days (analysis)
Mercury	P, G	Cool to 4 C	28 days
Organochlorine Pesticides	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
PCBs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
VOCs[1]	G-TLS or G-TLC	Cool to 4 C	14 days
SVOCs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
Moisture Content	P, G	Cool to 4 C	NA
Total Organic Carbon	G-TLC	Cool to 4 C	28 days
Soil Bulk Density	P, G	Cool to 4 C	NA
pH	P, G	Cool to 4 C	Immediately upon receipt

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

Notes:
1. Samples shall not contain headspace. Solid samples collected in EnCore samplers must be transferred to a soil sample vial within 48 hours.

TABLE B-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: GROUNDWATER

Intended Use: Nature and extent of contamination
Quantitative risk assessment - human health and ecological

QC Level: 100% Level III

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Hardness	PBW-SOP-10	By Calculation	NA	SM 2340B
Total Dissolved Solids	PBW-SOP-10	Gravimetric	NA	EPA 160.1
Total Suspended Solids	PBW-SOP-10	Gravimetric	NA	EPA 160.2
Total Organic Carbon	PBW-SOP-10	Carbonaceous Analyzer	NA	SW-846 9060
Chloride	PBW-SOP-10	Colorimetric	NA	SW-846 9251
Sulfate	PBW-SOP-10	Turbidimetric	NA	SW-846 9038
Major Anions (Ca, Mg, K, Na)	PBW-SOP-10	ICP-AES	SW846 3010A	SW846 6010B
Chromium VI	PBW-SOP-10	Colorimetric	NA	SW846 7196A
Metals	PBW-SOP-10	ICP-AES	SW846 3010A	SW846 6010B
Mercury	PBW-SOP-10	Cold Vapor AA	SW846 7470A	SW846 7470A
Organochlorine Pesticides	PBW-SOP-10	GC	SW846 3510C	SW846 8081A
PCBs	PBW-SOP-10	GC	SW846 3510C	SW846 8082
VOCs	PBW-SOP-10	GC/MS	SW846 5030B	SW846 8260B
SVOCs	PBW-SOP-10	GC/MS	SW846 3510C	SW846 8270C
NAPL Analyses				
Specific Gravity	PBW-SOP-10	gravimetric	NA	SM 2710F
Organochlorine Pesticides	PBW-SOP-10	GC	NA	SW846 8081A
VOCs	PBW-SOP-10	GC/MS	NA	SW846 8260B
SVOCs	PBW-SOP-10	GC/MS	NA	SW846 8270C

TABLE B-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: GROUNDWATER

Laboratory Parameters	Container	Preservation	Holding Time
Hardness	P, G	HNO3 to pH < 2	6 months
Total Dissolved Solids	P, G	Cool to 4 C	7 days
Total Suspended SolidS	P, G	Cool to 4 C	7 days
Total Organic Carbon	P, G	HCl to pH < 2[1] Cool to 4 C	28 days
Chloride	P, G	Cool to 4 C	28 days
Sulfate	P, G	Cool to 4 C	28 days
Major Anions (Ca, Mg, K, Na)	P, G	HNO3 to pH < 2	6 months
Chromium VI	P, G	Cool to 4 C	24 hours
Metals	P, G	HNO3 to pH < 2	6 months
Mercury	P, G	HNO3 to pH < 2	28 days
Organochlorine Pesticides	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
PCBs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
VOCs[2]	G-TLS	HCl to pH < 2[1] Cool to 4 C	14 days
SVOCs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

Notes:
1. H_2SO_4 or solid $NaHSO_4$ are also acceptable preservatives.
2. Samples shall not contain headspace or air bubbles.

TABLE C-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: SURFACE WATER

Intended Use: Quantitative risk assessment - human health and ecological

QC Level: Level III with Level IV for 10% of the sample sets (selected by RI Manager with consideration given to sample results, location and matrix)

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Hardness	PBW-SOP-10 BESI-SOP-600	By Calculation	NA	SM 2340B
Total Dissolved Solids	PBW-SOP-10 BESI-SOP-600	Gravimetric	NA	EPA 160.1
Total Suspended Solids	PBW-SOP-10 BESI-SOP-600	Gravimetric	NA	EPA 160.2
Total Organic Carbon	PBW-SOP-10 BESI-SOP-600	Carbonaceous Analyzer	NA	SW-846 9060
Chloride	PBW-SOP-10 BESI-SOP-600	Colorimetric	NA	SW-846 9251
Sulfate	PBW-SOP-10 BESI-SOP-600	Turbidimetric	NA	SW-846 9038
Major Anions (Ca, Mg, K, Na)	PBW-SOP-10 BESI-SOP-600	ICP-AES	SW846 3010A	SW846 6010B
Chromium VI	PBW-SOP-10 BESI-SOP-600	Colorimetric	NA	SW846 7196A
Metals (total)	PBW-SOP-10 BESI-SOP-600	ICP-AES	SW846 3010A	SW846 6010B
Metals (dissolved)	PBW-SOP-10 BESI-SOP-600	ICP-AES	SW846 3010A	SW846 6010B
Mercury	PBW-SOP-10 BESI-SOP-600	Cold Vapor AA	SW846 7470A	SW846 7470A
Organochlorine Pesticides	PBW-SOP-10 BESI-SOP-600	GC	SW846 3510C	SW846 8081A
PCBs	PBW-SOP-10 BESI-SOP-600	GC	SW846 3510C	SW846 8082
VOCs	PBW-SOP-10 BESI-SOP-600	GC/MS	SW846 5030B	SW846 8260B
SVOCs	PBW-SOP-10 BESI-SOP-600	GC/MS	SW846 3510C	SW846 8270C

TABLE C-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: SURFACE WATER

Laboratory Parameters	Container	Preservation	Holding Time
Hardness	P, G	HNO3 to pH < 2	6 months
Total Dissolved Solids	P, G	Cool to 4 C	7 days
Total Suspended Solids	P, G	Cool to 4 C	7 days
Total Organic Carbon	P, G	HCl to pH < 2(1) Cool to 4 C	28 days
Chloride	P, G	Cool to 4 C	28 days
Sulfate	P, G	Cool to 4 C	28 days
Major Anions (Ca, Mg, K, Na)	P, G	HNO3 to pH < 2	6 months
Chromium VI	P, G	Cool to 4 C	24 hours
Metals (total)	P, G	HNO3 to pH < 2	6 months
Metals (dissolved)	P, G	Filter onsite HNO3 to pH < 2	6 months
Mercury	P, G	HNO3 to pH < 2	28 days
Organochlorine Pesticides	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
PCBs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)
VOCs(2)	G-TLS	HCl to pH < 2(1) Cool to 4 C	14 days
SVOCs	G-TLC (Amber)	Cool to 4 C	7 days (preparation) 40 days (analysis)

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

Notes:
1. H_2SO_4 or solid $NaHSO_4$ are also acceptable preservatives.
2. Samples shall not contain headspace or air bubbles.

TABLE D-1 - PARAMETERS AND METHOD SPECIFICATIONS

MEDIA: SEDIMENT

Intended Use: Investigate possibility of additional Potential Source Areas
Nature and extent of contamination
Quantitative risk assessment - human health and ecological

QC Level: Level III with Level IV for 10% of the sample sets (selected by RI Manager with consideration given to sample results, location and matrix)

Laboratory Parameters	Sampling SOP	Measurement Technique	Preparation Method	Analysis Method
Chemical Analyses				
Total Moisture	BESI-SOP-101; BESI-SOP-102	Gravimetric	NA	SM 2540G
Chloride	BESI-SOP-101; BESI-SOP-102	Colorimetric	NA	SW846 9251
Sulfate	BESI-SOP-101; BESI-SOP-102	Turbidimetric	NA	SW846 9038
Chromium VI	BESI-SOP-101; BESI-SOP-102	Colorimetric	SW846 3060A	SW846 7196A
Metals	BESI-SOP-101; BESI-SOP-102	ICP-AES	SW846 3050B	SW846 6010B
Mercury	BESI-SOP-101; BESI-SOP-102	Cold Vapor AA	SW846 7471A	SW846 7471A
Organochlorine Pesticides	BESI-SOP-101; BESI-SOP-102	GC	SW846 3550B cleanup (e.g., 3620B) as needed	SW846 8081A
PCBs	BESI-SOP-101; BESI-SOP-102	GC	SW846 3550B cleanup (e.g., 3665A) as needed	SW846 8082
VOCs	BESI-SOP-101; BESI-SOP-102	GC/MS	SW846 5035	SW846 8260B
SVOCs	BESI-SOP-101; BESI-SOP-102	GC/MS	SW846 3550B cleanup (e.g., 3640A) as needed	SW846 8270C
Grain-Size	BESI-SOP-101; BESI-SOP-102	NA	NA	ASTM C-136
Total Organic Carbon	BESI-SOP-101; BESI-SOP-102	NA	NA	SW846 415.1/9060

TABLE D-2 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: SEDIMENT

Laboratory Parameters	Container	Preservation	Holding Time
Chemical Analyses			
Chloride	P, G	Cool to 4 C	28 days
Sulfate	P, G	Cool to 4 C	28 days
Chromium VI	P, G	Cool to 4 C	30 days (preparation) 4 days (analysis)
Metals	P, G	Cool to 4 C	6 months
Mercury	P, G	Cool to 4 C	28 days
Organochlorine Pesticides	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
PCBs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
VOCs[(1)]	G-TLS or G-TLC	Cool to 4 C	14 days
SVOCs	G-TLC	Cool to 4 C	14 days (preparation) 40 days (analysis)
Grain-Size	P, G	none	none
Total Organic Carbon	P, G	Cool to 4 C	28 days

P – Polyethylene G – Glass TLC – Teflon®-lined cap TLS – Teflon®-lined septum

TABLE E-1 - ANALYTES AND METHOD SPECIFICATIONS

MEDIA: FISH TISSUE

Intended Use: Quantitative risk assessment - human health

QC Level: Level IV for all sample sets

Laboratory Parameters	Sampling Method	Measurement Technique	Preparation Method SOP	Analysis Method SOP
Chemical Analyses				
TBD[(1)]	BESI-SOP-303; BESI-SOP-304	---	---	---

Note:
1. TBD = To be determined; laboratory parameters will be determined following analysis and review of Intracoastal Waterway sediment data, as detailed in the RI/FS Work Plan.

TABLE E-3 - SAMPLE CONTAINER, PRESERVATION AND HOLDING TIME REQUIREMENTS

MEDIA: FISH TISSUE

Laboratory Parameters	Container	Preservation	Holding Time
TBD[(1)]	PTFE, G, HRAF	Cool to 4 C or Freeze at ≤ 20 C (archive samples)	See Note 2

PTFE – Polytetrafluoroethylene (Teflon) G – Glass HRAF - Hexane-rinsed aluminum foil

Note:

1. TBD = To be determined; laboratory parameters will be determined following analysis and review of Intracoastal Waterway sediments, as detailed in the RI/FS Work Plan.
2. Holding time depends on selected laboratory analyses that will be identified following evaluation of the Intracoastal Waterway sediment data. Fish tissue samples (finfish and crab) may be archived for up to 6 months prior to analysis (EPA, 2000b. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1*. OW/EPA 823-B-00-007, November).

Appendix D

Practical Quantitation Limits for Analytical Data, As Prescribed in PRP QAPP (March 2006)

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Total Moisture	Std Methods 2540 G	0.01	0.01	NA	NA	NA	NA	NA	30	NA	NA	NA
Chloride	9251	3.3	10	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	17	50	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.67	2	NA	NA	70-130	<MQL	70-130	30	50	NA	NA
ICP metals												
Aluminum	6010B	2.7	8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Antimony	6010B	0.33	2.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Arsenic	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Barium	6010B	0.33	1	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Beryllium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Boron	6010B	1.1	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cadmium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cobalt	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Copper	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Iron	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lead	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lithium	6010B	0.67	2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Manganese	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Nickel	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Selenium	6010B	0.44	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Silver	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Thallium	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Titanium	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Zinc	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Mercury	7471A	0.007	0.02	NA	0.995	80-120	<MQL	70-130	30	50	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.0008	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDE	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDT	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aldrin	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-Chlordane	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
beta-BHC	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
delta-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Dieldrin	8081A	0.0005	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan I	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan II	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan sulfate	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin aldehyde	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin ketone	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-BHC (Lindane)	8081A	0.001	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-Chlordane	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor epoxide	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Methoxychlor	8081A	0.0067	0.02	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Toxaphene	8081A	0.0667	0.2	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1221	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1232	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1242	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1248	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1254	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1260	8082	0.0233	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Individual Congeners	8082	0.0066	0.0066	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,3-Trichloropropane	8260B	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dibromo-3-chloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dibromoethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrylonitrile	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromomethane	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butanol	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dichlorodifluoro-methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl Acetate	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylcyclohexane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
SEMIVOLATILE ORGANICS												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4,5-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitrophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloroaniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthylene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetophenone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Aniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzaldehyde	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Benzidine	8270C	0.067	1.32	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzoic acid	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzyl alcohol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Biphenyl	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.105	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Caprolactam	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbazole	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chrysene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenzofuran	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Diethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluorene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachloroethane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isophorone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Nitrobenzene	8270C	0.019	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.065	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE A-4 - QUALITY CONTROL OBJECTIVES
MEDIA: SOIL

Analyte	Method[1]	Target MDL[2] (mg/Kg)	Target MQL[3] (mg/Kg)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
n-Nitrosodi-n-propylamine	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodiphenylamine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Cresol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenanthrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Pyridine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Hardness	Std Methods 2340B	0.23	0.66	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Total Dissolved Solids (TDS)	EPA 160.1	10	10	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Suspended Solids	EPA 160.2	1	1	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Organic Carbon	9060	1	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chloride	9251	0.333	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	1.67	5	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.008	0.02	NA	NA	70-130	<MQL	70-130	30	40	NA	NA
ICP Metals												
Aluminum	6010B	0.067	0.2	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Antimony	6010B	0.006	0.06	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Arsenic	6010B	0.01	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Barium	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Beryllium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Boron	6010B	0.333	1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cadmium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cobalt	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Copper	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Iron	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lead	6010B	0.003	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lithium	6010B	0.017	0.05	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Manganese	6010B	0.005	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Nickel	6010B	0.002	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Selenium	6010B	0.013	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Silver	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Thallium	6010B	0.0029	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Titanium	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Zinc	6010B	0.007	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
MERCURY	7470A	0.0002	0.0004	NA	0.995	80-120	<MQL	70-130	30	40	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.000025	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDE	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDT	8081A	0.000018	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aldrin	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
alpha-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
alpha-Chlordane	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
beta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
delta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Dieldrin	8081A	0.000015	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan I	8081A	0.000009	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan II	8081A	0.000024	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan sulfate	8081A	0.000009	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin	8081A	0.000025	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin aldehyde	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin ketone	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-BHC (Lindane)	8081A	0.000016	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-Chlordane	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor	8081A	0.000014	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor epoxide	8081A	0.000022	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Methoxychlor	8081A	0.00003	0.0005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Toxaphene	8081A	0.000825	0.005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1221	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1232	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1242	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1248	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1254	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1260	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Individual Congeners	8082	0.00002	0.00002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
1,2,3-Trichloropropane	8260B	0.0007	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromo-3-chloropropane	8260B	0.0003	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromoethane	8260B	0.0004	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0008	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrylonitrile	8260B	0.0017	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butanol	8260B	0.038	0.1	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dichlorodifluoro methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0004	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl Acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylcyclohexane	8260B	0.008	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Semivolatile Organics												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.0011	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,5-Trichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.01	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitroaniline	8270C	0.0073	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitrophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.002	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3-Nitroaniline	8270C	0.0073	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.0006	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloroaniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.0006	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetophenone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Aniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Anthracene	8270C	0.0006	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.003	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzaldehyde	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzidine	8270C	0.0108	0.04	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Benzo(a)anthracene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.0002	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzoic acid	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzyl alcohol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Biphenyl	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.0008	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.0008	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Caprolactam	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbazole	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chrysene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.0005	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenzofuran	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Diethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluoranthene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluorene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.001	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.0028	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachloroethane	8270C	0.0022	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C	0.0013	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isophorone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Nitrobenzene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.0018	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodi-n-propylamine	8270C	0.0004	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE B-4 - QUALITY CONTROL OBJECTIVES

MEDIA: GROUNDWATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
n-Nitrosodiphenylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Cresol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenanthrene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyrene	8270C	0.0004	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyridine	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 “Test Methods for Evaluating Solid Waste.”
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory’s initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Hardness	Std Methods 2340B	0.23	0.66	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Total Dissolved Solids (TDS)	EPA 160.1	10	10	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Suspended Solids	EPA 160.2	1	1	NA	NA	NA	<MQL	NA	30	NA	NA	NA
Total Organic Carbon	9060	1	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chloride	9251	0.333	1	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	1.67	5	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.008	0.02	NA	NA	70-130	<MQL	70-130	30	40	NA	NA
ICP Metals												
Aluminum	6010B	0.067	0.2	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Antimony	6010B	0.02	0.06	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Arsenic	6010B	0.013	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Barium	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Beryllium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Boron	6010B	0.333	1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cadmium	6010B	0.002	0.005	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Cobalt	6010B	0.003	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Copper	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Iron	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lead	6010B	0.003	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Lithium	6010B	0.017	0.05	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Manganese	6010B	0.005	0.015	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Nickel	6010B	0.002	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Selenium	6010B	0.013	0.04	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Silver	6010B	0.002	0.01	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Thallium	6010B	0.003	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Titanium	6010B	0.033	0.1	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Zinc	6010B	0.007	0.02	NA	0.995	90-110	<MQL	70-130	30	40	NA	NA
Mercury	7470A	0.0002	0.0004	NA	0.995	80-120	<MQL	70-130	30	40	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.000007	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDE	8081A	0.000017	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
4,4'-DDT	8081A	0.000018	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Aldrin	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
alpha-BHC	8081A	0.000007	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
alpha-Chlordane	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
beta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
delta-BHC	8081A	0.00002	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Dieldrin	8081A	0.000015	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan I	8081A	0.000009	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan II	8081A	0.000024	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endosulfan sulfate	8081A	0.000009	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin	8081A	0.000025	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin aldehyde	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Endrin ketone	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-BHC (Lindane)	8081A	0.000016	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
gamma-Chlordane	8081A	0.00003	0.0001	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor	8081A	0.000014	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Heptachlor epoxide	8081A	0.000022	0.00005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Methoxychlor	8081A	0.00003	0.0005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Toxaphene	8081A	0.000825	0.005	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1221	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1232	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1242	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1248	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1254	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Aroclor-1260	8082	0.00067	0.002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Individual Congeners	8082	0.00002	0.00002	20	0.99	+/-15	<MQL	60-140	40	40	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,3-Trichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromo-3-chloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dibromoethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acrylonitrile	8260B	0.0073	0.025	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butanol	8260B	0.038	0.1	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Cyclohexane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dichlorodifluoro-methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0004	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl Acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylcyclohexane	8260B	0.008	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Semivolatile Organics												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.002	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,5-Trichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.0024	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.01	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Chlorophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
2-Nitrophenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.0005	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
3-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chloroaniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitroaniline	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
4-Nitrophenol	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acenaphthylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Acetophenone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Aniline	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Anthracene	8270C	0.0006	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzaldehyde	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzidine	8270C	0.0133	0.04	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(a)anthracene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzo(k)fluoranthene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzoic acid	8270C	0.0167	0.05	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Benzyl alcohol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Biphenyl	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Caprolactam	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Carbazole	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Chrysene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dibenzofuran	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Diethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluoranthene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Fluorene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.0028	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Hexachloroethane	8270C	0.0022	0.005	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

TABLE C-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SURFACE WATER

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Indeno(1,2,3-cd)pyrene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Isophorone	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Nitrobenzene	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodi-n-propylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
n-Nitrosodiphenylamine	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
o-Cresol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenanthrene	8270C	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Phenol	8270C	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyrene	8270C	0.0004	0.002	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%
Pyridine	8270C	0.0067	0.02	15	0.99	+/-20	<MQL	60-140	40	40	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Total Moisture	Std Methods 2540 G	0.01	0.01	NA	NA	NA	NA	NA	30	NA	NA	NA
Chloride	9251	3.3	10	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Sulfate	9038	17	50	NA	NA	70-130	<MQL	70-130	30	NA	NA	NA
Chromium (VI)	7196A	0.67	2	NA	NA	70-130	<MQL	70-130	30	50	NA	NA
ICP Metals												
Aluminum	6010B	2.7	8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Antimony	6010B	0.67	2.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Arsenic	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Barium	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Beryllium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Boron	6010B	1.1	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cadmium	6010B	0.07	0.2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Cobalt	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Copper	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Iron	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lead	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Lithium	6010B	0.67	2	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Manganese	6010B	0.2	0.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Nickel	6010B	0.53	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Selenium	6010B	0.44	1.6	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Silver	6010B	0.13	0.4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Thallium	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Titanium	6010B	1.3	4	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
Zinc	6010B	0.27	0.8	NA	0.995	90-110	<MQL	70-130	30	50	NA	NA
MERCURY	7471A	0.007	0.02	NA	0.995	80-120	<MQL	70-130	30	50	NA	NA
Organochlorine Pesticides												
4,4'-DDD	8081A	0.0012	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDE	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
4,4'-DDT	8081A	0.0011	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aldrin	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
alpha-Chlordane	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
beta-BHC	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
delta-BHC	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Dieldrin	8081A	0.0007	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan I	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan II	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endosulfan sulfate	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin aldehyde	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Endrin ketone	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-BHC (Lindane)	8081A	0.0005	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
gamma-Chlordane	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor	8081A	0.0007	0.002	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Heptachlor epoxide	8081A	0.0013	0.004	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Methoxychlor	8081A	0.0067	0.02	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Toxaphene	8081A	0.028	0.2	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Polychlorinated Biphenyls												
Aroclor-1016	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1221	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1232	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1242	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1248	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1254	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Aroclor-1260	8082	0.0227	0.07	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Individual Congeners	8082	0.0066	0.0066	20	0.99	+/-15	<MQL	60-140	40	50	60-140	NA
Volatile Organics												
1,1,1,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,1-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2,2-Tetrachloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1,2-Trichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,1-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,3-Trichloropropane	8260B	0.0007	0.002	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,4-Trichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2,4-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dibromo-3-	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
chloropropane												
1,2-Dibromoethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloroethene (Total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3,5-Trimethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,3-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
1,4-Dichlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,2-Dichloropropane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Butanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloroethylvinyl ether	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Hexanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorotoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Isopropyltoluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Methyl-2-pentanone	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetone	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrolein	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acrylonitrile	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromodichloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromoform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bromomethane	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butanol	8260B	0.0083	0.025	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon disulfide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbon tetrachloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chlorobenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloroform	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
cis-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
cis-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Dibromochloromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibromomethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dichlorodifluoro-methane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Ethylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobutadiene	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isopropylbenzene (Cumene)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl Acetate	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methyl iodide	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylcyclohexane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Methylene chloride	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Propylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Xylene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
sec-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Styrene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butyl methyl ether (MTBE)	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
tert-Butylbenzene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Tetrachloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Toluene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,2-Dichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,3-Dichloropropene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
trans-1,4-Dichloro-2-butene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichloroethene	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorofluoromethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Trichlorotrifluoroethane	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl acetate	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Vinyl chloride	8260B	0.0017	0.005	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Xylene (total)	8260B	0.0033	0.01	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Semivolatile Organics												
1,2Diphenylhydrazine/ Azobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
2,4,5-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4,6-Trichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dichlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dimethylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,4-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2,6-Dinitrotoluene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chloronaphthalene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Chlorophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Methylnaphthalene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
2-Nitrophenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3,3'-Dichlorobenzidine	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
3-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4,6-Dinitro-2-methylphenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Bromophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloro-3-methylphenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chloroaniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Chlorophenyl phenyl ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitroaniline	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
4-Nitrophenol	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthene	8270C	0.016	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acenaphthylene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Acetophenone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Aniline	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Atrazine (Aatrex)	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzaldehyde	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzidine	8270C	0.067	1.32	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(a)pyrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(b)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzo(g,h,i)perylene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc. [6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Benzo(k)fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzoic acid	8270C	0.55	1.65	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Benzyl alcohol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Biphenyl	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethoxy)methane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroethyl)ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Chloroisopropyl)ether	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Bis(2-Ethylhexyl)phthalate	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Butyl benzyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Caprolactam	8270C	0.22	0.66	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Carbazole	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Chrysene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenz(a,h)anthracene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dibenzofuran	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Diethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Dimethyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-butyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Di-n-octyl phthalate	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluoranthene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Fluorene	8270C	0.019	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachlorocyclo-pentadiene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Hexachloroethane	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Indeno(1,2,3-cd)pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Isophorone	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Nitrobenzene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodimethylamine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodi-n-propylamine	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
n-Nitrosodiphenylamine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
o-Cresol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenanthrene	8270C	0.022	0.066	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Phenol	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

TABLE D-4 - QUALITY CONTROL OBJECTIVES

MEDIA: SEDIMENT

Analyte	Method[1]	Target MDL[2] (mg/L)	Target MQL[3] (mg/L)	Max %RSD[4]	Min r (Correl. Coeff)	CCV[5] REC.	Blank Conc.[6]	LCS MS/ MSD REC.[7]	Analytical Dup RPD	Field Dup RPD	SU REC.[7]	IS Area[8]
Pyrene	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%
Pyridine	8270C	0.11	0.33	15	0.99	+/-20	<MQL	60-140	40	50	60-140	-50 to +100%

Notes:

1. Unless otherwise indicated, analytical methods are from EPA SW-846 "Test Methods for Evaluating Solid Waste."
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B. The MDL listed here is the maximum method detection limit that will support the project performance objectives. Sample Detection Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
3. Method Quantitation Limits correspond to the lowest non-zero concentration standard in the laboratory's initial calibration curve calculated using the normal aliquot sizes and final volumes prescribed in the analytical method. The MQL listed here is based on typical laboratory performance. Sample Quantitation Limits (which are adjusted to reflect sample-specific actions, such as dilution or use of smaller aliquot sizes than prescribed in the analytical method, and take into account sample characteristics, sample preparation, sample cleanup, and analytical adjustments including dry-weight adjustments) will be higher.
4. Per the analytical methods for organics, the %RSD for an individual analyte may exceed the criteria as long as the mean %RSD for all calibrated analytes is within the criteria. For data qualification purposes, the %RSD criteria will be applied to each individual analyte and the data flagged accordingly. For GC/MS analyses, the analytical method also includes criteria for the Relative Response Factor (RRF) for a subset of the calibrated analytes. For data qualification purposes, a minimum RRF criteria of 0.05 will be applied to each individual analyte and the data flagged accordingly.
5. Per the analytical methods for organics, the CCV response for an individual analyte may be outside the criteria as long as the mean CCV response for all calibrated analytes is within the criteria. For data qualification purposes, the CCV criteria will be applied to each individual analyte and the data flagged accordingly. For inorganics, the same limits apply for the ICV.
6. Criteria apply for all blank types including method blanks, calibration blanks, equipment blanks, and trip blanks. For data qualification purposes, blank concentrations for all positively identified analytes (i.e., above the detection limit) will be assessed and the data flagged accordingly. However, laboratory corrective action is instituted only for concentrations above the quantitation limit.
7. Criteria are for data qualification purposes. The laboratory shall monitor performance and institute routine corrective action using the laboratory-established limits but the lower limit shall not be below 10% for organics and 30% for inorganics.
8. Expressed as percent of area for internal standard in midpoint calibration standard.

TABLE E-2 - QUALITY CONTROL OBJECTIVES

MEDIA: FISH TISSUE

Analyte	Method	Method Detection Limit [2]	ICV REC.	CCV REC.	LCS REC.	MS/MSD REC.	MS/MSD RPD	ICB Conc.[3]	Method Blank Conc.
TBD[1]									

Notes:

1. TBD = To be determined; laboratory parameters will be determined following analysis and review of Intracoastal Waterway sediment data, as detailed in the RI/FS Work Plan.
2. Method Detection Limits are determined by the laboratory using the procedures in 40 CFR Part 136, Appendix B and are verified annually by the laboratory. The MDL listed here is the maximum detection limit that will support the project performance objectives.
3. Initial Calibration Standards are prepared at various concentration levels.

Appendix E

PRP Standard Operating Procedures

PASTOR, BEHLING & WHEELER, LLC

LIST OF STANDARD OPERATING PROCEDURES

SOP Number	Title	Revision No. and Date
1	FIELD DOCUMENTATION	Rev No. 1 Sept. 2005
2	SUPERVISION OF EXPLORATORY BORINGS	Rev No. 2 Oct. 2005
3	FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES	Rev No. 1 Sept. 2005
4	GEOPHYSICAL LOGGING	Rev No. 0 Sept. 2005
5	SOIL AND SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS	Rev No. 1 Oct. 2005
6	SAMPLE CUSTODY, PACKAGING AND SHIPMENT	Rev No. 0 Dec. 2002
7	INSTALLATION OF MONITORING WELLS AND PIEZOMETERS	Rev No. 1 Sept. 2005
8	MONITORING WELL DEVELOPMENT	Rev No. 0 Jan. 2005
9	WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT	Rev No. 1 Sept. 2005
10	WATER QUALITY SAMPLING	Rev No. 1 Sept. 2005
11	FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)	Rev No. 0 Dec. 2002
12	FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)	Rev No. 0 Dec. 2002
13	EQUIPMENT DECONTAMINATION	Rev No. 0 Dec. 2002
14	STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK	Rev No. 0 Dec. 2002
15	HYDRAULIC TESTING	Rev No. 1 Sept. 2005
16	DATA VALIDATION (included in SAP Volume II – QAPP)	Rev No. 1 Oct. 2005

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 1

FIELD DOCUMENTATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol for documenting field activities. PBW field personnel shall document field activities on formatted field records and other appropriate data sheets. These formatted record and data sheets will be part of the PBW project file; all forms must be filled out carefully and completely by one of the personnel actually performing the field activities.

2.0 PROCEDURES

2.1 Daily Field Record

The PBW field representative will prepare a Daily Field Record form (Figure SOP-1-1) for each day of field work. As appropriate, documentation on the multiple-page form will include:

A. Project identification;

B. Date;

C. Time on job (beginning and ending time);

D. Weather conditions;

E. Activity description;

F. List of personnel and visitors on site;

G. Safety equipment used and monitoring performed;

H. Waste storage inventory (if any);

I. Chronological record of activities and events;

J. Comments and variances from project work plan;

K. Content of telephone conversations; and

L. Signature of the PBW field representative.

The PBW field representative will document details as necessary to recreate the day's activities and events at a later time, using as many additional sheets as needed. The Daily Field Record also can be used to document field activities that may not be specified on other field record forms. Other activity-specific documentation requirements that can be recorded on the Daily Field Record are discussed in the PBW Standard Operating Procedure (SOP) for each activity.

3.0 DOCUMENTATION

3.1 Field Record Forms

In addition to the Daily Field Record, PBW field personnel will complete specific PBW field record forms applicable to the field activities being conducted. The procedures for completion of activity-specific field record forms are presented in the applicable PBW Standard Operating Procedures. Some of the PBW field record forms include:

- Daily Field Record (SOP No. 1);
- Log of Boring (SOP No. 2);
- Chain-of-Custody Record and Request for Analysis (SOP No. 6);
- Monitoring Well Installation (SOP No. 7);
- Monitoring Well Development (SOP No. 8);
- Water Level Monitoring Record (SOP No. 9);
- Groundwater Sampling Record and Surface Water Sampling Record (SOP No. 10);
- Eh Data Sheet (SOP No. 11); and
- Slug Test Form (SOP No. 15).

3.2 Records Management

All original field forms will be filed with the appropriate project's records.

4.0 QUALITY ASSURANCE

4.1 Form Review and Filing

Completed field forms should be reviewed by the Project Manager or project designated QA/QC reviewer. Any necessary corrections will be made in pen with a single-line strike out that is initialed and dated.

FIGURE SOP-1-1. DAILY FIELD RECORD

DAILY FIELD RECORD	DATE:	PAGE 1 of _____

Project Number: Project Name:

Location: Time on Job: AM/PM to: AM/PM

Weather Conditions:

Activity:

PERSONNEL ON SITE

Name	Company	Time In	Time Out

VISITORS ON SITE

Name	Company/Agency	Time In	Time Out

PERSONAL SAFETY

	Protective Gloves		Hard Hat		Tyvek Coveralls
	Protective Boots		Safety Goggles/Glasses		Respirator (Half/Full)
	Hearing Protection				

Other Safety Equipment (describe):

SAFETY EQUIPMENT

Monitoring Equipment:	Serial / Rental No.	**Field Calibration:** Std.	Result

WASTE STORAGE INVENTORY

Container Type	Container ID	Description of Contents and Quantity	Location

SIGNATURE OF FIELD REPRESENTATIVE:

DATE:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664

Phone: (512) 671-3434 Fax: (512) 671-3446

FIGURE SOP-1-1. DAILY FIELD RECORD

DAILY FIELD RECORD *(continued)*	DATE:	PAGE _____ of _____

TIME	DESCRIPTION OF DAILY ACTIVITIES & EVENTS

COMMENTS / COMMUNICATIONS:

SIGNATURE OF FIELD REPRESENTATIVE:

DATE:

Pastor, Behling & Wheeler, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664
Phone: (512) 671-3434 Fax: (512) 671-3446

Pastor, Behling & Wheeler, LLC.

STANDARD OPERATING PROCEDURE No. 2

SUPERVISION OF EXPLORATORY BORINGS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed by Pastor, Behling & Wheeler, LLC (PBW) personnel during the drilling and logging of exploratory borings. Exploratory borings (pilot holes) may be drilled to obtain samples of the subsurface strata or to run borehole geophysical logs. Borings will be either backfilled with grout or completed as monitoring wells or piezometers.

The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications to the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Drilling

For any site or drilling location, the selection of drilling methods will be based on: (1) availability and cost of the method; (2) suitability for the type of geologic materials at the site (e.g., consolidated, unconsolidated); (3) potential effects on sample integrity (influence by drilling fluids and potential for cross contamination between aquifers); or (4) or other site-specific considerations. Some commonly used drilling methods include hollow-stem auger method, cone penetrometer testing (CPT) method, direct-push geoprobe method, hydraulic rotary method, cable tool method, or casing-hammer air rotary method. Synthetic polymer drilling fluid additive should be used only if a boring: (1) will not be sampled for chemical analysis; (2) will not be completed as a monitoring well; or (3) if cuttings return and/or borehole integrity cannot be achieved by any other method.

Exploratory borings for monitoring wells and piezometers will be drilled in a manner that will minimize the potential for cross contamination between water-bearing units. The actual depth of

each exploratory boring will be specified by the PBW field supervisor assigned to the drill rig and will be based on the intended use of the boring. No solvents or petroleum-based products will be used for lubricating any drilling equipment (rods, bit, augers, mud pit, etc.) which will contact the borehole or the drilling fluid. For air rotary drilling, an air filter will be installed between the air compressor and the drill pipe to intercept oil droplets.

The drilling equipment in which fluid (including air) circulates, including drive samplers and bits, will be thoroughly steam cleaned before and after drilling of each exploratory boring. Only clean, potable water will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (e.g., 0.1 N HCl) or solvent rinse (e.g., methanol or hexane) may be used to supplement these procedures if tarry or oily deposits are encountered during drilling. Drilling equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

To ensure that the specified equipment has been provided by the drilling contractor, prior to drilling the PBW field supervisor will measure and record the outside diameter of the drill bit or augers and, when using the hollow stem auger method, the inside diameter of the augers.

During drilling, the PBW field supervisor may choose to periodically measure and record the depth to water within the drill casing. The position of the lead drill casing will be recorded each time a water level measurement is taken. When the total depth of a boring is reached, the water level within the drill casing will be measured.

If the boring is to be completed as a monitoring well or a piezometer, the final borehole diameter will be sufficiently large to allow placement of a specified type and size of well casing, screen and filter pack. The PBW field supervisor will measure and record the total depth of the final borehole at the completion of drilling.

The PBW field supervisor shall specify to the driller the penetration rate, depth of soil sample collection, method of sample retrieval, and any other matters which pertain to the satisfactory completion of the exploratory borings.

Soil cuttings and drilling fluid generated during drilling should be temporarily stored in steel drums or other approved containers. Final disposal of the soil cuttings and drilling fluid will be

conducted in accordance with all regulatory requirements and with procedures discussed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids, and Water Generated During Field Work.

2.2 Sampling and Logging

Representative samples of cores and/or drill cuttings may be obtained and evaluated. A detailed lithologic log of these samples should be made.

Selected samples may be retained for further physical analysis. Soil samples may also be obtained for chemical analysis. Sample collection and preservation for chemical analysis will be in accordance with PBW SOP No. 5 entitled Soil and Sediment Sampling For Chemical Analysis. Selected samples that illustrate specific geologic features may be retained and shall be labeled with boring number and appropriate sample interval.

2.2.1 Obtaining Samples

When samples are collected, they should be obtained by one or both of the following methods described below.

A. Coring -- Cores will be collected from selected intervals of the exploratory borings. Core barrels, Pitcher tubes, or other split-spoon drive samplers will be used to obtain the soil cores. As appropriate, the PBW field supervisor will carefully record on a boring log information which applies to the coring, such as rate of penetration, coring smoothness, core recovery, intervals of core loss, zones of lost circulation of drilling fluid, hammer weight, drop length and blow counts, as appropriate to the drilling method.

   Cores may be retained for future examination and/or preserved for chemical or geotechnical analysis. If they are retained, the cores may be stored and labeled to show project, boring number, date, and cored interval.

B. Collecting Cuttings -- The PBW field supervisor may collect cuttings from the drilling return fluid, air return from a cyclone separator, or the auger blade for every five-foot (or more frequent) increment of the exploratory boreholes. As appropriate, sampling and logging should be performed in accordance with the following procedures (Note: Items 2 through 6 do not apply to drilling methods that do not use a drilling fluid, e.g., hollow stem auger, push point sampler, etc.):

   1. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods or augers should be taken into account in calculating the depth of penetration.

2. A small-diameter, fine-mesh hand screen or a shovel may be used to obtain a sample of the cuttings from the boring by holding the sampling device directly in the flow of the drilling return fluid or cyclone separator.

3. A sample will be obtained from the drilling return fluid or cyclone separator by leaving the sampling device in place only for the brief period required to collect an adequate sampling volume.

4. The most representative cuttings samples are usually obtained whenever the driller stops advancing the hole and circulates drilling fluid or air prior to adding another joint of drill rod.

5. Keep in mind that the deeper the hole, the longer cuttings at the drill bit take to reach the surface. The travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after fluid or air circulation is resumed. This travel time should be used along with the depth of penetration to estimate the start and finish of each sampling interval.

6. In hydraulic rotary drilling, carefully wash the cutting sample in a bucket of fresh water by slowly shaking the screen while the sample is submerged, to wash away the drilling fluid.

7. For all drilling methods, place the cutting samples on a sampling table, labeled in consecutive order. If the sample is to be retained, place the sample in a plastic or cloth sample bag labeled with the boring number and sample interval. The retained samples will later be used during preparation of a detailed lithologic log.

2.3 Logging of Boreholes

The drill-rig operator and the PBW field supervisor should discuss significant changes in material penetrated by the drill bit, changes in drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The PBW field supervisor will be present during drilling of exploratory borings and will observe and record such changes by time and depth. When using a drilling method that does not involve the use of a wet drilling fluid, the PBW field supervisor should evaluate the relative moisture content of the samples and note zones that produce water. The PBW field supervisor may record such field notes to use later in preparing a detailed lithologic log.

Core samples and selected cuttings that are collected and retained during the drilling of the exploratory borings should be examined to evaluate the lithologic properties. A detailed lithologic log for the exploratory borings should be completed using PBW's Log of Boring (Figure SOP-2-1). The lithologic description of the log may include soil or rock type, color, grain

size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information. Color may be described using the Munsell Color Chart. Soil type should be described using the Unified Soil Classification System (USCS). When the Log of Boring form is used, it should include the method of sample collection (coring, cuttings) and the sample collection interval (Figure SOP-2-1), if any samples are collected.

Field personnel may also describe soil samples according to *Standard Practice for Description and Identification of Soils, Visual-Manual Procedure, ASTM D2488*. These procedures for lithology logging may include the following:

1) Measure entire sample length and record recovery (if applicable).

2) Mark lithologic changes on Field Log of Boring form (Figure SOP-2-1).

3) Separate a small, representative portion of each distinct soil type to be identified.

4) Describe the lithology, which may include soil or rock type, grain size, texture, hardness, degree of induration, calcareous content, indications of contamination, and other pertinent information.

5) Identify the color using a Munsell color chart.

6) Identify the soil type using the field tests outlined in ASTM 2488-84.

7) Record descriptions of the soil on the Field Log of Boring form (Figure SOP-2-1). The descriptions should be in the following order:
   a) Soil color;
   b) Soil type (USCS);
   c) Moisture content;
   d) Cementation;
   e) Consistency;
   f) Angularity and shape of particles (if sand or gravel);
   g) Dilatancy/dry strength
   h) Plasticity; and
   i) Miscellaneous descriptors (roots, nodules, odors, texture percentages).

8) Dispose all remaining soil samples and cuttings in secure containers and store in an access-controlled central storage area on the Site. The containers should be properly labeled with the generation date, drilling location, and matrix.

2.4 Geophysical Logs

PBW SOP No. 4 entitled Geophysical Logging discusses in detail the steps to be followed when performing geophysical logs of exploratory borings. Geophysical logging is generally performed

in uncased, fluid-filled boreholes. Following completion of the drilling, spontaneous potential, single-point resistance, lateral resistivity, natural gamma or other logs may be made for each exploratory boring immediately after the drilling fluid has been circulated to remove all of the cuttings. When performed, geophysical logging should be done as quickly and efficiently as possible, while the wall of the borehole is in good condition, to minimize the possibility of trapping or entangling the downhole probes. Instruments on the logging unit should be adjusted to give the maximum definition of strata boundaries.

2.5 Plugging and Abandonment

For borings (pilot holes) not used to install a monitoring well and/or piezometer, the exploratory borings will be abandoned by plugging the hole with cement grout or other approved sealing agents. The PBW field supervisor shall inspect the grout for adequate mixing prior to placement in the borehole.

If the borehole is dry and is less than 10-feet deep, the grout or other approved sealant may be poured slowly from the ground surface into the borehole. The grout should be added in one continuous pour before its initial set. If the borehole is greater than 10-feet deep, or if more than 2-feet of water is present in the borehole, the grout is typically placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially should be placed near the bottom of the bore hole and shall remain submerged in the grout during the entire grouting operation. Grout should continue to be pumped until return of fresh grout (uncontaminated by drilling fluid) is observed at the ground surface.

A typical grout mix is one (1) sack of Type I-II Portland cement, five (5) percent by weight of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite grout (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage may be reduced to two (2) percent. The grout mixture may be modified to meet local regulations or site-specific conditions or specifications.

2.6 Documentation and Records Management

Field notes recorded by the PBW field supervisor during the drilling of each exploratory boring should be recorded directly on or transferred to the log form (Figure SOP-2-1). The original logs

shall be placed in the PBW project file. A copy of the logs will be retained in the field file for the project. For preparation of the report, data from the field boring logs may also be transferred to another format.

3.0 QUALITY ASSURANCE

Field notes and field forms completed by the field supervisor shall be reviewed by the task manager and the PBW Project Manager or other designated QA officer before they are placed into project files. The QA review will be recorded on the reviewed originals by initials of reviewer and date.

Figure SOP-2-1

PBW

PASTOR, BEHLING & WHEELER, LLC
2201 DOUBLE CREEK DRIVE, SUITE 4004
ROUND ROCK, TEXAS 78664
(512) 671-3434 FAX: (512) 671-3446

FIELD LOG OF BORING: (Page ___ of ___)

Location:	Logged By:
Drilling Method:	Ground Elevation:
Drilling Company & Driller Lic. No.:	Date(s):
Project No.	Sampler Type: / Drill Bit(s):

Depth	Recovery	Sample	PID (ppm-v)		Description/Remarks USCS Description, Color; Moisture Structure: stratified, laminated, fissured, slickensided, blocky, lensed, homogenous

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 3

FIELD ORGANIC VAPOR SCREENING METHODOLOGY FOR SOIL SAMPLES

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during field screening of soil samples for organic vapors using portable organic vapor meters (OVMs), such as a photoionization detector (PID) or a flame ionization detector (FID). Personnel responsible for the use of these instruments must be familiar with the manufacturer's use, calibration and maintenance instructions. The procedures presented herein are intended to be general in nature and, when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Equipment List

- OVM(s) (PID and/or FID);
- OVM calibration kit (refer to instrument manufacturer's instructions; may include calibration gas, tedlar bag, regulator, connectors);
- Indelible marker (SANFORD Sharpie®, space pen, or equivalent); and
- One-quart, zip-lock plastic bags.

2.2 Operational Factors

Common OVM operational factors which may affect performance during field vapor screening may include, but are not limited to, the following:

2.2.1 PID

A. Photoionization lamp requires periodic cleaning/changing.

B. Moist atmospheric conditions (i.e., rain) and high relative humidity (>90%) in the sample or ambient air can "quench" the signal resulting in high readings. If the ambient temperature is less than the soil temperature, water vapor can condense in the PID ion chamber. Ideal conditions for conducting PID analyses are dry

weather and ambient air temperatures greater than 50 degrees Fahrenheit (10 degrees Centigrade).

C. Dust particles may absorb ultraviolet light, which reduces the energy emitted. Constituents in the dust may ionize and cause erratic responses in PID's that do not have filters. Note that the ThermoEnvironmental Instruments Models 580A and 580B do have particulate filters.

D. Sampling from a source of limited air volume will restrict the instrument air flow and provide anomalously low instrument readings.

E. Responses may be affected by interference from nearby AC or DC power lines, transformers, high voltage equipment, or radio wave transmitters.

F. The PID does not detect methane or other alkanes, thus eliminating anomalous methane contributions to total concentration readings.

2.2.2 FID

A. Low oxygen levels can influence the instrument response or cause the flame to be extinguished.

B. Recommended ambient air temperature is greater than 40 degrees Fahrenheit (4 degrees Centigrade).

C. High winds may extinguish the flame.

D. The FID requires a relatively high sample flow rate for reliable readings. Restricting the flow rate can yield inaccurate results, erratic responses, and may extinguish the flame.

E. The FID detects the total concentration of many organic vapors and gases (methane, other alkanes and aromatics). It may yield anomalously high readings (false positives) when evaluating potential hydrocarbon contamination in situations where methane is present (i.e., wetlands, sewers, septic leach fields, decaying organic matter, etc.).

F. Hydrogen gas is required for operation.

2.3 Field Operations

OVM(s) should be calibrated and operated according to the manufacturer's specifications to yield total organic vapors (TOV) in parts per million (ppm) by volume.

2.3.1 Calibration and Testing

Use ambient air (background) where "zero" air is called for in the calibration procedure. Calibration should be performed at least once at the beginning of each work day and in accordance with the instrument manufacturer's instructions.

1. If using a PID with a filter, verify that the particulate filter is properly inserted, and that the filter is not dirty or clogged.

2. Measure concentration of TOV in background air in vicinity of location where screening will be done. If ambient air was used as the "zero" air in the calibration procedure, the background concentration should be approximately zero.

3. Measure concentration of TOV within empty plastic zip-lock bags.

   A. Remove a plastic zip-lock bag at random from its packaging;

   B. Open top of bag completely;

   C. Immediately insert OVM probe to middle of bag; and

   D. Record highest reading on the appropriate Field Logs.

4. Check operation of OVM(s) by holding the tip of an indelible marker, or other organic vapor source, approximately one-half inch away from the end of the OVM probe and observing for meter deflection. Any positive deflection of OVM is indicative of proper function. Verify that OVM(s) returns to background levels. This procedure should be performed periodically during the work day. Be careful not to get ink on the OVM probe.

5. Document calibration in the Daily Field Record where indicated on the form. The Daily Field Record is presented in PBW SOP No. 1 entitled Field Documentation.

2.3.2 Operation

1. Label each plastic zip-lock bag before the bag is used (it is much easier to write on the bag when it is empty and flat).

2. Fill bag approximately one-half full with the soil sample. Seal bag immediately under ambient conditions. Do not attempt to inflate or evacuate bag while closing. Crush the sample by squeezing sample through the bag with fingers to provide greater surface area for vapor outgassing. Agitate the sample for

approximately 15 seconds. The agitation period should be generally consistent for samples collected at the site in the same time period.

3. Allow headspace development for approximately 10 minutes at ambient air temperature. The headspace development period should be generally consistent for all samples collected from the site in the same time period.

4. Subsequent to headspace development, agitate the sample again for approximately 15 seconds. While holding top of plastic zip-lock bag, press end of OVM probe into corner of zip-lock closure and hold the remainder of zip-lock area closed around probe. Keep the end of the probe at approximately the center of the airspace within the bag. Exercise care to avoid uptake of water droplets or soil particulates into the OVM probe.

5. Record the highest reading obtained with the OVM. If using a ThermoEnvironmental Instruments Models 580A or 580B PID, the response time should be less than 2 seconds. If using different instrument(s), the manufacturer's specifications should be checked for the expected response time(s).

6. After screening each sample, verify that the OVM returns to previous background ambient air levels and/or record any changes. Record OVM measurements on a Log of Boring form (Figure SOP-2-1) or in a field notebook.

7. Discard the contents of the plastic zip-lock bag into container with other soil cuttings. Discard the zip-lock bag appropriately with other wastes.

2.4 Documentation and Record Management

Instrument calibration will be recorded with date, time and calibration results. OVM measurements for soil samples or borehole cuttings/cores will also be recorded with date, time and TOV results. This information may be included on the Daily Field Record form (Figure SOP-1-1), Log of Boring (Figure SOP-2-1) or in a field notebook.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Instrument calibration results must demonstrate that the OVM is in good working condition and can provide TOV measurements within the range expected for soils at the designated sample locations. If the instrument operation is not confirmed through the calibration and testing procedure described in Section 2.3.1 then the instrument should be tagged as "Non-Operational/Defective" and repaired or replaced immediately.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 4

GEOPHYSICAL LOGGING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for borehole geophysical logging. Borehole geophysical logs of exploratory borings may be run to aid in the interpretation and correlation of geologic units. The procedures include calibration, production, filing, and interpretation of the geophysical logs. The procedures presented herein are intended to be general in nature; when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Geophysical Well-Logging Equipment Operating Procedures

The geophysical well-logging equipment (GWLE) should be capable of performing single-point resistance, lateral resistivity, spontaneous potential, and natural gamma-ray logging as appropriate depending on project requirements.

2.1.1 GWLE Setup

The GWLE shall be arranged as follows at the borehole to be logged:

A. Place tripod over well or use pulley (sheave) suspended from drill rig.

B. Set cable reel and chart recorder sections near the borehole.

C. Attach power source (vehicle battery, generator, or line current) to GWLE.

D. Attach probe (spontaneous potential/resistance - resistivity, or gamma) to cable head.

E. Run probe and cable over tripod pulley or sheave suspended from drill rig and into the borehole.

F. Place electrical ground in mud pit or other suitable location (for spontaneous potential/resistance - resistivity logging only) in accordance with equipment specifications and project health and safety requirements.

The probe should be referenced to the ground surface elevation of the borehole by placing the probe reference mark at ground level and setting the depth counter on the cable reel section to zero.

The chart recorder section of the GWLE should be checked to determine the following:

A. Pens have sufficient ink to log the entire borehole;

B. Pen drives are working properly;

C. Chart paper is of sufficient quantity to log the entire borehole; and

D. Vertical scale is set at 1 inch = 10 feet or other suitable scale.

2.1.2 GWLE Calibration

The GWLE should be calibrated before starting both spontaneous potential/resistance - resistivity (SP/RES) and natural gamma ray (gamma) logging by following the detailed procedures in the GWLE operator manual.

2.1.3 Setting Scales

After calibration, the probe is lowered to the bottom of the borehole. While lowering the probe, the proper SP/RES or gamma scales are selected as follows:

A. SP/RES Logging:

As the probe is lowered to the bottom of the borehole, the SP and RES scales and zero adjust controls should be adjusted so that the pen has maximum deflection without going off the chart paper.

B. Gamma Logging:

1. Set time constant switch on chart recorder to 3 seconds or other suitable setting.

2. Lower the probe to bottom of borehole and observe pen deflection. Select a "recorder output" setting (gamma scale) that gives maximum pen deflection without the pen going off the chart paper (to the right).

3. The time constant switch should be adjusted to give good definition of relatively thin geologic features without showing too much "background noise".

4. Selection of a time constant and gamma scale is generally possible only while logging the borehole. After the first borehole in the drilling program has been

logged, a gamma scale and time constant may be selected for gamma logging of subsequent holes.

The scale settings and the depth at which logging will start shall be recorded on the chart paper.

2.1.4 Logging Procedure

Log the boring in accordance with the following procedure:

A. For SP/RES and gamma logging, reel the probe(s) up at an even steady rate at the speed recommended in the detailed equipment procedures. Monitor the speed by observing the instrument's rate meter.

B. Reel probe to the ground surface (which should correspond to zero on the depth counter) and record on the chart paper the actual pen position at zero depth (as indicated by the depth counter). Also record the depth of fluid in the hole, as indicated by the SP and RES curves.

The spontaneous potential/resistance - resistivity and natural gamma traces on the chart paper shall be checked in the field by the PBW field supervisor for completeness of record, and rechecked to determine if the traces are representative of assumed subsurface conditions. If the traces on the chart paper appear to be non-representative or peculiar, the instrument shall be checked for a possible malfunction and the borehole re-logged.

2.2 Documentation and Records Management

The geophysical log furnished by a geophysical logging subcontractor should include the following items below (A through R) on the subcontractor's logging form. The following data should be recorded on the logging form soon after the logs have been run:

A. Project number;

B. Date;

C. Boring description/location;

D. Log type (e.g., single-point resistance, spontaneous potential, natural gamma);

E. Scale settings;

F. Starting and completion depths of geophysical logs;

G. Datum (measuring point, MP) of logs;

H. Borehole depth and diameter;

I. Casing depth(s) and diameter(s);

J. Ground surface elevation of well (if available);

K. Type of borehole fluid;

L. Temperature of borehole fluid;

M. Level of borehole fluid (datum is measuring point);

N. Resistivity or specific conductance of borehole fluid;

O. Logging speed;

P. Vertical scale of log;

Q. Name of operator of GWLE and name of witness (if any); and

R. Pertinent remarks.

The PBW field supervisor will document the logging activities on either the Daily Field Record (Figure SOP-1-1), Log of Boring form (Figure SOP-2-1), or the Well Completion form (Figure SOP-7-1). The original geophysical log (or a reproducible copy) should be filed in the PBW project files. Copies of the logs may be retained in the field.

2.3 Interpretive Procedure

The geophysical logs may be compared to and correlated with the lithologic log of the same exploratory boring in order to evaluate the accuracy and precision of the interpretation, refine the interpretive technique, evaluate the interpretive limits of the geophysical logging procedure, and aid in identifying the hydrostratigraphic units. Geophysical logs and lithologic logs of the cored intervals of borings will be compared in order to formulate a control group to be used for correlation of uncored borings.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Cleaning of Equipment

The logging probes, electrical cable and all accessories that have been in contact with the drilling fluid or have entered the borehole should be thoroughly cleaned after each trip in and out of the borehole. See PBW SOP No. 13 entitled Equipment Decontamination for additional decontamination procedures.

3.2 Technical Review

Geophysical logs, lithologic logs, and interpretive reports based on those logs should be reviewed by a geologist with experience and training in geophysics. The technical review should be performed before interpretive results are reported and record of that review should be included in the project's files along with other documentation of geophysical logging.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 5

SOIL AND SEDIMENT SAMPLING FOR CHEMICAL ANALYSIS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocols to be followed when soil and sediment samples are collected for physical or chemical analysis. The procedures presented herein apply to: soil sampling from the surface, soil sampling when drilling boreholes, and sediment sampling from surface waters, wetlands, drainage structures, etc. These procedures are intended to be general in nature. Appropriate revisions may be made when approved by the PBW Project Manager to address site-specific conditions or project-specific protocols.

2.0 PROCEDURES

2.1 Surface Soil and Sediment Sample Collection

This section describes sampling of soils and sediment from near the land surface, including the bottom or sides of an excavation and the bottom of a surface water drainage course. The collected samples will be placed in appropriate sample containers, as designated by the laboratory, for the parameters to be analyzed.

2.1.1 Surface Soil Sampling

Soil will be removed using a spade and, if necessary, a post-hole digger to the top of the targeted sampling interval.

A. Direct Sampling Method -- A stainless-steel or, as appropriate, plastic instrument (trowel, scoop) will be used to recover the sample directly into appropriate containers provided by the analytical laboratory.

B. Manual Core Sampler Method -- A slide-hammer core sampler with brass or stainless steel liners may be used to recover a relatively undisturbed core sample. Extension sections may be added to reach deeper sampling intervals. This method is recommended for samples that will be analyzed for volatile organic compounds.

C. Hand Auger Method -- A hand auger with stainless-steel auger and sampler sections may be used to advance and sample the boring. Extension sections may be added to reach deeper sample intervals.

2.1.2 Sampling Sediment in a Surface Water Course

Sediment in a surface water course with little or no free water may be sampled by directly scooping the sample with a stainless steel or, as appropriate, plastic instrument (trowel, scoop). All sediments, including sediment submerged under water, may be sampled by the following methods:

A. Direct Sampling Method -- Fluid sediment may be collected directly using the sample container. If sampled under water, the container will be capped in place to avoid disturbance while surfacing.

B. Manual Core Sampler Method -- A slide-hammer core sampler with brass or stainless steel liners may be used to recover a relatively undisturbed core sample of the sediment. An extension section may be added to reach sediment intervals in deeper waters.

C. Remote Scoop Method -- A sampling cup or container attached to a pole may be used to collect a sediment sample in deeper water or where a longer reach is needed.

D. Bottom Sampling Dredge Method -- A sampling dredge attached to a cable also may be used to recover sediment samples in deeper waters.

2.2 Sample Collection During the Drilling of Borings

During borehole drilling, core samples may be collected for chemical analysis by lining the core barrel or drive sampler with clean brass or stainless steel liners. The procedures for obtaining soil cores are discussed in PBW SOP No. 2 entitled Supervision of Exploratory Borings. The drive sampler or core barrel will be steam cleaned or washed with a laboratory-grade detergent and water solution to remove dirt, rinsed with tap water, and then rinsed with distilled or deionized water prior to and between sampling. Upon disassembly of the soil sampler by the drilling contractor, the PBW field supervisor will take possession of the core. The core will be parted at the joints between the liners using a clean, sharp, stainless steel knife or spatula or similar implement. The most representative liner(s) in the drive sampler will be preserved for chemical analysis.

Methods for the collection and analysis of VOCs in soil or other solid matrices will be conducted to minimize volatile losses. An option for minimizing volatilization during soil sampling is to follow the general procedures detailed in the EPA Method 5035, Closed-System Purge-and-Trap Extraction for Volatile Organics in Soil and Waste Samples provided in the EPA SW-846, Update III dated June 1997. EPA SW-846 Method 5035 does not rigorously dictate specifics of field sample collection and laboratory sample handling protocols. The following procedures to minimize volatile losses in soil samples are suggested:

1. Samples are handled as intact soil cores in the field and laboratory.
2. Samples are stored in containers (i.e., EnCore® or similar sampling tools) which can be reliably sealed to prevent volatilization losses over the project specified analytical holding time.
3. Samples are analyzed or chemically (acid or methanol) preserved within 48 hours of collection, if any contaminant may undergo biodegradation. Longer holding times may be implemented by freezing the samples immediately after collection and during shipment to the laboratory.
4. Exposure of the sample core to the atmosphere in the field and laboratory should be minimized.

2.3 Sample Preservation

The soil or sediment sample shouldl be quickly inspected for color, appearance, and composition, then capped immediately. If brass or stainless steel liners are used, the ends of the tube will be covered with Teflon® sheeting and then capped with clean polyethylene slip caps. The capped ends will be sealed with duct tape. If samples will be placed in laboratory provided sample jars, the jar will be filled to the capacity of the jar and the lid will be securely tightened. The sample liner or jar will be placed in a plastic, ziplock bag and stored (in an ice-cooled, insulated chest, if necessary) until delivery to the laboratory.

2.4 Sample Labeling

The sample container should be labeled with self-adhesive tags. Each sample will be labeled with the following information in waterproof ink:

A. Project identification;

B. Sample identification;

C. Date and time sample was obtained;

D. Sample Depth Interval (feet below ground level); and

E. First initial and last name of sample collector(s).

2.5 Documentation and Record Management

2.5.1 Daily Field Record

A PBW field representative will document the activities of each day of field work chronologically in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation. For soil sampling, the Daily Field Record (included in PBW SOP No. 1) or field notebook entries may include the following items:

A. Decontamination Record: Decontamination method, source of tap water or deionized water, type of detergent or other cleaning agent;

B. Sample Inventory Record: Sample identification, location, date and time of sampling, sample depth interval, analyses requested and analysis methods;

C. Sampling Location Map: Surface soil sampling only, include scale, orientation, sample locations tied into a permanent reference point and sample identifications; and

D. Sampling Equipment Record: Description of sampling methodology and equipment including unique equipment identification, if available.

Copies of these records will be placed in the project files. Sample location and depth information should also be included in any electronic database maintained for the project.

2.5.2 Log of Boring Activity

As appropriate, the depth intervals of the soil samples collected for chemical analysis, the sampling date and times, and the sample identifications will be documented by the PBW field supervisor on the Log of Boring forms (included in PBW SOP No. 2 entitled Supervision of

Exploratory Borings) in the portion of the boring log corresponding to the sample interval. The original Log of Boring will be placed in the PBW project file.

2.5.3 Sample Custody

A Chain-of-Custody and Request for Analysis (CC/RA) form should be filled out for every sampling event or shipment, whichever is more frequent. Sample custody procedures and CC/RA form are discussed in PBW SOP No. 6 entitled Sample Custody, Packaging and Shipment.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

The sampler, liners, polyethylene end caps, parting knife, and any tools used in the assembly and disassembly of the sampler should be cleaned before and after each use. Equipment should be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable water, then rinsing with distilled or deionized water. Alternatively, the equipment may be steam cleaned followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Record Review

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure and the other procedures referenced herein.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 6

SAMPLE CUSTODY, PACKAGING AND SHIPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) generally describes the protocol to be followed for sample custody, packaging and shipment. Appropriate revisions may be made when approved by the PBW Project Manager.

This SOP applies to any liquid or solid sample that is being transported by the sampler, a courier or an overnight delivery service.

2.0 PROCEDURES

The objectives of this packaging and shipping SOP are: to minimize the potential for sample breakage, leakage or cross contamination; to provide for preservation at the proper temperature; and to provide a clear record of sample custody from collection to analysis.

2.1 Packaging Materials

The following is a list of materials that are typically needed to facilitate proper sample packaging:

- Chain-of-Custody Record forms (Figure SOP-6-1, or as provided by the laboratory);
- Coolers (insulated ice chests) or other shipping containers as appropriate to sample type;
- Transparent packaging tape;
- Zip-lock type bags (note: this is used as a generic bag type, not a specific brand name);
- Protective wrapping and packaging material; and
- Contained ice (packaged and sealed to prevent leakage when melted) or "Blue Ice".

2.2 Sample Custody from Field Collection to Laboratory

After samples have been collected, they will be maintained under chain-of-custody procedures. These procedures are used to document the transfer of custody of the samples from the field to the designated analytical laboratory. The same chain-of-custody procedures will be used for the transfer of samples from one laboratory to another, if required.

The field sampling personnel will complete a Chain-of-Custody Record and Request for Analysis (CC/RA) form (Figure SOP-6-1 or the CC/RA form provided by the laboratory) for each separate container of samples to be shipped or delivered to the laboratory for chemical or physical (geotechnical) analysis. Information contained on the form will include:

1. Project identification;
2. Date and time of sampling;
3. Sample identification;
4. Sample matrix type;
5. Sample preservation method(s);
6. Number and types of sample containers;
7. Sample hazards (if any);
8. Requested analyses;
9. Requested sample turnaround time;
10. Method of shipment;
11. Carrier/waybill number (if any);
12. Signature of sampling personnel;
13. Name of PBW Project Manager;
14. Signature, name and company of the person relinquishing and the person receiving the samples when custody is being transferred; and
15. Date and time of sample custody transfer.

The sampling personnel whose signature appears on the CC/RA form is responsible for the custody of a sample from time of sample collection until the custody of the sample is transferred to a designated laboratory, a courier, or to another PBW employee for the purpose of transporting a sample to the designated laboratory. A sample is considered to be in their custody when the custodian: (1) has direct possession of it; (2) has plain view of it; or (3) has securely locked it in a restricted access area.

Custody is transferred when both parties to the transfer complete the portion of the CC/RA form under "Relinquished by" and "Received by." Signatures, printed names, company names, and date and time of custody transfer are required. Upon transfer of custody, the PBW sampling personnel who relinquished the samples will retain a copy of the CC/RA form. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the CC/RA form.

2.3 Packaging and Shipping Procedure

Be sure that all sample containers are properly labeled and all samples have been logged on the CC/RA form in accordance with the procedures explained above.

All samples should be packed in the cooler so as to minimize the possibility of breakage, cross-contamination and leakage. Before placing the sample containers into the cooler, be sure to check all sample bottle caps and tighten if necessary. Bottles made of breakable material (e.g., glass) should also be wrapped in protective material (e.g., bubble wrap, plastic gridding, or foam) prior to placement in the cooler. Place the sample containers upright in the cooler. Avoid stacking glass sample bottles directly on top of each other.

If required by the method, samples should be preserved to 4°C prior to the analysis. Water ice or "blue ice" may be used to keep the sample temperatures at 4°C. The ice may be placed in zip-lock bags between and on top of the sample containers to maximize the contact between the containers and the bagged ice.

If there is any remaining space at the top of the cooler, packing material (e.g., styrofoam pellets or bubble wrap) should be placed to fill the balance of the cooler. After filling the cooler, close the top and shake the cooler to verify that the contents are secure. Add additional packaging material if necessary.

When transport to the laboratory by the PBW sampler is not feasible, sample shipment should occur via courier or overnight express shipping service that guarantees shipment tracking and next morning delivery (e.g., Federal Express Priority Overnight). In this case, place the chain-of-custody records in a zip-lock bag and place the bag on top of the contents within the cooler. Tape the cooler shut with packaging tape. Packaging tape should completely encircle the cooler.

2.4 Documentation and Records Management

The CC/RA form, Daily Field Records, or a field notebook with field notes may be kept describing the packaging procedures and the method of shipments. Copies of all chain-of-custody records and CC/RA forms (Figure SOP-6-1) will be retained in the project files. CC/RA forms provided by the laboratory will be acceptable as well.

3.0 QUALITY ASSURANCE

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-6-1. CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

CHAIN-OF-CUSTODY RECORD AND REQUEST FOR ANALYSIS

PBW, LLC. COC No. _____

Round Rock Office
2201 Double Creek Drive, Suite 4004
Round Rock, TX 78664
TEL: (512) 671-3434
FAX: (512) 671-3446

PROJECT NO.: _____ PROJECT NAME: _____ PAGE: _____ OF: _____

SAMPLER (Signature): _____ PROJECT MANAGER: _____ DATE: _____

METHOD OF SHIPMENT: _____ CARRIER/WAYBILL NO.: _____ DESTINATION: _____

SAMPLES														ANALYSIS REQUEST								
		Sample Collection			Preservation						Containers			Constituents/Methods					Handling			Remarks
Lab No.	Field Sample Identification	DATE	TIME	Matrix*	HCl	HNO_3	H_2SO_4	COLD		FILTRATION*	VOLUME (ml/oz)	TYPE*	NO.						HOLD	RUSH	STANDARD	
	TOTAL NUMBER OF CONTAINERS													LABORATORY COMMENTS/CONDITION OF SAMPLES								Cooler Temp:

RELINQUISHED BY:			DATE	TIME	RECEIVED BY:		
SIGNATURE	PRINTED NAME	COMPANY			SIGNATURE	PRINTED NAME	COMPANY
							LABORATORY

*KEY: Matrix: AQ - aqueous NA - nonaqueous SO - soil SL - sludge P - petroleum A - air OT - other Containers: P - plastic G - glass T - teflon B - brass OT - other Filtration: F - filtered U - unfiltered

DISTRIBUTION: PINK: Field Copy YELLOW: Laboratory Copy WHITE: Return to Originator

Pastor, Behling & Wheeler,

STANDARD OPERATING PROCEDURE No. 7

INSTALLATION OF MONITORING WELLS AND PIEZOMETERS

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during installation of monitoring wells and piezometers by PBW. The procedures presented herein are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Monitoring Well Installation

Each monitoring well will be designed to register the potentiometric surface and to permit water sampling of a specific depth zone encountered beneath the drill site. Separate monitoring wells may be completed, as necessary, in the different water-yielding zones underlying the site. The PBW field supervisor, in consultation with the PBW Project Manager as needed, will specify the exact depths of screened intervals using the lithologic log and geophysical log (if performed) for control. Drilling and logging of the exploratory borings for the monitoring wells will be conducted in accordance with PBW SOP No. 2 entitled Supervision of Exploratory Borings. Construction and completion of all monitoring wells will be in general conformance with the following procedures. Specific monitoring well completion requirements may vary in accordance with project-specific work plans and/or local regulatory agency guidance.

2.1.1 Screens and Riser Casing

The monitoring well assembly shall consist of flush joint, threaded casing composed of mild steel, stainless steel or polyvinyl chloride (PVC) Schedule 40 (minimum). The threaded joints will have O-ring seals. Steel casing joints may be welded rather than threaded. The inside diameter of both the perforated and unperforated casing will be sufficiently large to permit easy passage of an appropriate water-level probe, equipment for development and purging of wells, and for collection of groundwater samples.

The perforated casing (well screen) will be factory slotted. The perforations will be compatible in size with the selected filter material. These perforated casing sections are generally not intended to provide optimum flow but only to provide hydraulic connection between the pervious material in the water-yielding zone and the monitoring well.

Prior to well construction, the PBW field supervisor will inspect the blank and perforated casing delivered to the job site to verify that it meets the project specifications.

When the total depth of a boring has been reached, and prior to installation of the well casing, the PBW field supervisor will measure and record the depth to water in the borehole.

Upon completion of drilling and/or geophysical logging, the monitoring well casing and screen will be assembled and lowered to the bottom of the boring. The monitoring well assembly will be designed so that the well screen is approximately adjacent to the water-yielding zone that is to be monitored. The bottom of the screen will be approximately flush with the bottom of the well and will be closed with a threaded PVC cap or plug, or a slip cap secured with stainless steel screws. No PVC cement or other solvents are permitted to be used to fasten the joints of the casing or screen. Centralizers spaced at the top and bottom of the screened interval and not more than 40 feet apart along the casing may be used to center the well assembly in the borehole, unless the boring is drilled by a low annular space method and the well is installed with the drill casing in place. Wells installed prior to pulling low annular space drill casing will be centered by the inside walls of the drill casing.

If well casing assembly is being performed by a drilling subcontractor, the PBW field supervisor will observe and inspect the assembly, insuring that the bottom cap is threaded or secured with stainless steel screws, O-rings are properly placed in the joints, the joints are completely tightened, and the blank and perforated intervals are constructed as specified. The PBW field supervisor will measure the location of the top and bottom of the perforated interval by measuring the distances from the joint above the perforated interval to the top slot and from the base of the bottom cap to the bottom slot.

When using the mud rotary drilling technique, after the monitoring well assembly has been lowered to the specified depth, clean water may be circulated downward through the well casing and upward through the annular space between the borehole wall and the monitoring well casing. Circulation will continue until the suspended sediment in the return fluid has been thinned.

If the well is greater than 50 feet deep, the casing assembly will be held under tension prior to and during emplacement of the filter pack and seal.

2.1.2 Filter Material

Filter material will be a well-graded, clean sand with less than 2 percent by weight passing a No. 200 sieve and less than 5 percent by weight of calcareous material.

Filter sand will be placed in the annular space using a one-inch diameter (or larger) pipe, in a calculated quantity sufficient to fill the annular space to a level of about two feet above the top of the perforated casing. The required height of the filter pack above the top of the perforated casing may vary by jurisdiction. The depth to the top of the filter pack should be verified by measuring, using the tremie pipe or a weighted steel tape. When use of a tremie pipe is not feasible, the filter sand may be poured slowly between the well casing and the inside walls of the auger, and the drill casing may be removed in stages.

2.1.3 Seal

Once the depth to the top of the filter pack has been verified, a layer of bentonite pellets or chips will be emplaced by pouring the pellets into the annular space in a calculated quantity sufficient to fill the annular space to a level at least one foot above the top of the filter pack. The depth to the top of the bentonite pellets/chips layer should be verified by measuring, using the tremie pipe or a weighted steel tape. When the bentonite pellets/chips are placed above the zone of saturation, they should be hydrated, after they have been emplaced, by adding clean, potable water. Approximately 1 gallon of water should be added for every foot of bentonite pellets/chips, which should be slowly poured into the borehole annualus to hydrate the pellets/chips. More water may be required when completing a well in relatively permeable material. The bentonite pellets/chips should be hydrated in lifts no greater than 3 feet.

A bentonite/cement grout seal or other approved sealant should be emplaced above the bentonite pellet layer after it has been allowed to hydrate for a minimum of ½ hour. If the depth to the top of the bentonite pellet layer is dry and is less than approximately 10 feet deep, the grout may be poured slowly from the ground surface into the annular space. The grout should be added in one continuous pour before its initial set. If the depth is greater than approximately 10 feet deep, or if

more than two feet of water is present in the annular space, the grout should be placed in one continuous pour by pumping through a tremie hose or pipe. The tremie hose or pipe initially should be placed near the top of the bentonite seal and shall remain submerged in the grout during the entire grouting operation. When constructing a well or piezometer inside a low annular space drill casing, the drill casing may be used as a tremie pipe by pouring the grout down the annular space between the well casing and the inner wall of the drill casing. Grout should continue to be pumped until return of fresh grout is observed at the ground surface.

The bentonite/cement grout mix should generally consist of one (1) sack of Type I-II Portland cement, five (5) percent by weight (of cement) of powdered bentonite, per 8.5 gallons of water. If a high-yield bentonite (trade names Quik-Gel, Super Gel X, etc.) is used, the powdered bentonite percentage may be reduced to two (2) percent. An alternative grout mixture may be used if approved by the applicable regulatory agency and the PBW Project Manager. Only clean water from a potable supply will be used to prepare the grout. The grout seal will extend from the top of the bentonite seal to near the ground surface. After grouting, no work will be done on the monitoring well until the grout has set for a minimum of 24 hours.

When the casing hammer air rotary or similar method is used to complete the borehole for a monitoring well, the protective casing will be jacked out of the borehole gradually as the filter pack, bentonite seal, and cementing operations are in progress.

2.1.4 Capping Monitoring Well

Upon completion of the work, a suitable watertight, cap or plug will be fitted on the top of the well casing to prevent the entry of surface runoff or foreign matter. The well will be completed either: (1) above the ground surface using a locking, steel protective well cover set in concrete; or (2) below the ground surface using a watertight, traffic-rated valve-box with a bolt-down cover.

2.2 Piezometer Installation

The piezometer should be designed to register the potentiometric surface of a specific depth zone encountered beneath the drill site. The PBW field supervisor, in consultation with the PBW Project Manager, will specify the exact depths of the piezometers using the lithologic log and geophysical log (if performed) for control. Drilling and logging of the boreholes for the piezometers will be in conformance with PBW SOP No. 2 entitled SUPERVISION OF

EXPLORATORY BORINGS. Construction, completion and development of the piezometers will generally follow the same procedures as those for monitoring wells (see Section 2.0 above), except that a piezometer may be completed with casing material of less than two inches in diameter and may use a porous tip (ceramic or other material) in place of perforated casing.

2.3 Documentation and Records Management

The PBW field supervisor will complete a Well Construction Summary form for each monitoring well (Figure SOP-7-1). The completed form should be included in the project files. In addition to the information requested on the Well Construction Summary form, the PBW field supervisor should record the volumes and types of well construction materials (filter material, bentonite, cement, etc.) used for each well in their field notes. Also, the daily events and other items not covered in the Well Construction Summary form will be entered on a Daily Field Record form in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Cleaning of Equipment Used in Drilling, Well Construction

The drilling equipment will be thoroughly steam cleaned before and after installation of each monitoring well or piezometer. Only clean, potable water will be used as makeup water for drilling fluid and for decontamination of drilling equipment. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement the steam cleaning if tarry or oily deposits are encountered. Equipment cleaned in this manner will be thoroughly steam cleaned prior to reuse or leaving the site.

Well casing that is not factory cleaned and in a sealed container be steam cleaned thoroughly before it is installed. After cleaning, the casing will be covered with plastic to protect it from contact with dust or other contaminants.

Equipment should be cleaned by scrubbing with a stiff brush using a laboratory-grade detergent/water solution, followed by rinsing with clean, potable, municipal water, then rinsing with distilled or deionized water. Alternatively, the equipment may be steam cleaned followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with municipal water and then with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

3.2 Records Review

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-7-1. WELL CONSTRUCTION SUMMARY FORM

Well Completion

WELL CONSTRUCTION SUMMARY

Well (number, ID, etc.) _____

Project: _____ Location: _____

Staff: Supervisor:

Elevation: Ground Level _____

Top of Casing:

DRILLING SUMMARY

Total Depth: _____ Borehole Dia.: _____

Driller: _____ Driller's Number: _____

Rig: _____ Bit(s): _____

Drilling Company: _____

Drilling Fluid:

CONSTRUCTION TIME LOG

TASK	START		FINISH	
Drilling:				
Geoph. Logging:				
Casing:				
Filter Placement:				
Bentonite Seal:				
Grout:				
Development:				
Other:				
Surface Comp.:				

WELL DESIGN:

Basis: Geologic Log _____ Geophysical Log _____

Casing String(s): C= CASING S= SCREEN

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

_____ - _____ _____ _____ - _____ _____

CASING: C1 _____

C2 _____

C3 _____

C4 _____

SCREEN: S1 _____

S2 _____

CENTRALIZERS: _____

FILTER MATERIAL: _____

BENTONITE SEAL: _____

CEMENT: _____

OTHER: _____

DECONTAMINATION: _____

COMMENTS: _____

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STANDARD OPERATING PROCEDURE No. 8

MONITORING WELL DEVELOPMENT

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during the development of groundwater monitoring wells. Monitoring wells must be developed before they are used to collect groundwater samples. The procedures presented are intended to be general in nature. As site-specific conditions become known, appropriate modifications of the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Development Procedure

After construction of the monitoring well is complete, the well may be developed by surging, bailing and/or pumping (e.g., positive displacement hand pump, electric pump or pneumatic pump). Typically, at least 24 hours should pass between completion of grouting of the monitoring well and development to allow sufficient curing of the grout.

The total depth of the well should be measured in accordance with the procedures described in PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement. The presence of sediment at the bottom of the well may be checked using a stainless steel bailer or positive displacement hand pump. Water and sediment should first be removed from the bottom of the well to ensure that the entire screened interval is open for water to flow into the well. The well should be bailed or pumped until the water removed from the bottom of the well is relatively free of sediment. If a bailer is used, care must be taken to avoid breaking the bottom cap on the well casing.

After most of the sediment has been removed from the bottom of the well, a well development pump (positive displacement hand pump, electric pump or pneumatic pump) may be used to remove water from the well. Initially, the intake of the pump should be at the bottom of the well. The pump intake should be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

Next, a surge block constructed of non-reactive material (usually stainless steel or PVC) may be used to develop the well screen by forcing water in and out of the screened area. The surge block should be moved up and down in one-to two-foot increments creating a suction action on the upstroke and a pressure action on the downstroke. Development should begin at the top of the water column and move progressively downward to prevent the surge block from becoming sand locked. After surging to the bottom of the well, the surge block should be moved progressively upward to the top of the water column.

If necessary, water may be added to the well to facilitate surging. This water should be distilled deionized or "clean" potable water. The volume of de-ionized water added to the well should be noted on the Well Development Record form (Figure SOP-8-1).

After surging, the surge block should be removed and replaced with the pump or bailer. The intake of the pump or bailer should be at the bottom of the well to remove any sediment that may have collected in the bottom of the well. The pump intake should again be raised in two- to three-foot increments to the top of the water column after approximately one-half of a casing volume of water has been removed from each interval.

During development, the pH, specific conductance and temperature of the purge water may be periodically measured and documented on a Well Development Record form. Parameter readings should be collected and noted for every casing volume of water removed from the well.

The well may be alternately surged and pumped until the field water quality parameters have stabilized to within 10% for specific conductance, 0.05 pH units for pH, and 1EC for temperature, and the water is relatively clear and free of sediment.

Water removed during well development should be temporarily stored in steel drums, a portable storage tank or other approved storage container. Final disposal of all water generated during development procedures will be conducted in accordance with all legal requirements and with procedures discussed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids, and Water Generated During Field Work.

2.2 Documentation and Records Management

A Well Development Record should be filled out by the PBW Field Supervisor for each well developed. Also, the daily events and other items not covered in the Well Development Record

should be entered on a Daily Field Record form in accordance with the procedures contained in PBW SOP No. 1 entitled Field Documentation.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Equipment Cleaning

All reusable equipment used in developing the monitoring well should be cleaned prior to and following use. Cleaning should be accomplished by either (1) washing with a laboratory-grade detergent/water solution, rinsing with clean, potable water, then rinsing with distilled or deionized water; or (2) steam cleaning followed by rinsing with distilled or deionized water. An acid rinse (0.1 N HCl) or solvent rinse (i.e., hexane or methanol) may be used to supplement these cleaning steps if tarry or oily deposits are encountered. The acid or solvent rinse will be followed by thoroughly rinsing with water. After final cleaning, equipment should be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminant when not in use.

3.2 Records Review

The Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-8-1. WELL DEVELOPMENT RECORD

WELL DEVELOPMENT RECORD

PAGE _____ of _____

Project Number: Project Name: Date:

Well Location (well ID, etc.): Starting Water Level (ft. BMP): _____

Developed by: Casing Stickup (ft.): _____

Measuring Point (MP) of Well: Starting Water Level (ft. BGL): _____

Screened Interval (ft. BGL): Total Depth (ft. BGL): _____

Filter Pack Interval (ft. BGL): Casing Diameter (In ID): _____

Casing Volume (gal.):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: _____

Purging: _____ Surge Equipment: _____

Disposal of Discharged Water:

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Other:

DEVELOPMENT MEASUREMENTS

Time	Flow		Water Quality			Appearance		Remarks
	Cum. Vol. (gal. / L)	Purge Rate (gal. / L pm)	Temp. (°C)	pH	Spec. Cond. (µmhos/cm)	Color	Turbidity & Sediment	

Total Discharge (gallons):

Observations/Comments:

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STANDARD OPERATING PROCEDURE No. 9

WATER LEVEL, IMMISCIBLE LAYER AND WELL DEPTH MEASUREMENT

1.0 SCOPE AND APPLICABILTIY

This Standard Operating Procedure (SOP) describes the protocol to be followed during measurement of water levels, immiscible layer and well depths in monitoring wells and piezometers. As the work progresses and when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

Before measuring fluid levels, the construction details and previous measurements for each well or piezometer shall be reviewed by the PBW field supervisor so any anomalous measurements may be identified. Well construction details and previous measurements shall be available in the field for review.

In general, fluid-level measurements shall be performed before groundwater is removed from the well by purging or sampling.

2.1 Equipment

Equipment that may be necessary to perform measurements includes:

- Well/piezometer construction details;
- Interface probe; and
- Fluid- Level Monitoring Record Sheet (From SOP 9-1);

2.2 Measuring Point

A measuring point (MP) shall be selected and marked for each monitoring well and piezometer in which water level measurements will be made. Generally, the MP will be the top of the well casing on the north side. The MP will be permanently marked using an indelible marker or a notch cut into the PVC casing. When the top-of-casing elevation of a monitoring well or piezometer is surveyed, the licensed surveyor should measure the MP elevation and reference this measurement to an appropriate datum (such as feet above mean sea level).

2.3 Fluid-Level Measurements

Fluid levels in all wells will be measured with an interface probe because of the presence or potential presence of non-aqueous phase liquid (NAPL) in the well. All fluid level measurements will be recorded to the nearest hundredth of one foot. Note the instrument used for each measurement on the Fluid Level Monitoring Record (Figure SOP-9-1).

The procedure for measuring water levels with an electric probe is as follows:

1. Switch on.

2. Lower the electric cable into the well until the ammeter or buzzer indicates a closed circuit. An intermittent beep indicates the presence of a light NAPL (LNAPL) or phase-separated hydrocarbons (PSH). A continuous beep indicates water.

3. With the cable in this fixed position, note the depth to the LNAPL (if encountered) and water from the Measuring Point (MP).

4. As necessary, check the total depth of the well below the MP using the interface probe by slowly lowering the probe to the bottom of the well and noting the depth.

5. If dense NAPL (DNAPL) is suspected to be present in the well, measure the bottom of the well with the interface probe in the "on" position and note if there is a change in the probe tone or blinking light..

6. If NAPL is not encountered, put an "NP" in the PSH column to indicate that NAPL (both LNAPL and DNAPL) was not present in the well.

Record the NAPL or PSH thickness in the "PSH Thickness" column of the Fluid Level Monitoring Record (Figure SOP-9-1). If LNAPL is not detected using the interface

probe, but the presence of LNAPL is suspected, the presence of a very thin layer or sheen (too thin to be measured) may also be checked using a bottom-filling transparent bailer. The presence of a thin LNAPL layer is checked by lowering the bailer into the well. Care must be taken to not completely submerge the bailer. Retrieve the bailer and visually examine the air/liquid interface for the presence of an immiscible light-phase layer or sheen. Note that the transparent bailer is not to be used to measure the thickness of LNAPL in a well.

3.0 DOCUMENTATION AND RECORDS MANAGEMENT

Fluid levels observed in wells selected for the groundwater monitoring network should be tabulated on a Fluid Level Monitoring Record form during each monitoring period (Figure SOP-9-1). The date and time of each measurement should also be recorded on the Fluid Level Monitoring Record. All fluid-level measurements should be recorded to the nearest 0.01 feet.

Fluid-level data should be recorded as feet below measuring point so that water level elevations should calculated from the depth-to-water measurement (from measuring point) and the surveyed elevation of the measuring point at each well or piezometer.

If LNAPL is encountered during water level measurement, the measured thickness or observation shall be recorded in the "Depth to Product" column. Each form or, as appropriate, individual measurement data, should be signed to indicate the originator.

4.0 QUALITY CONTROL

4.1 Equipment Decontamination/Cleaning

The interface probe should be cleaned before and after each measurement. Cleaning should be accomplished by washing with a laboratory-grade detergent/water solution, rinsing with clean, potable, water, wiping or spraying with isopropyl alcohol (if needed), then rinsing with distilled or deionized water. After cleaning, equipment will be packaged and sealed in plastic bags or other appropriate containers to minimize contact with dust or other contaminants.

4.2 Technical and Records Reviews

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

In addition, all calculations of water-level elevations and NAPL correction to water-level elevations (if necessary) should be reviewed before they are submitted to the project file and used to describe site conditions. Technical personnel familiar with this procedure should perform the calculation review. Evidence of the completed review and any necessary corrections to calculations should also be included in the project file.

FIGURE SOP-9-1. FLUID LEVEL MONITORING RECORD

FLUID LEVEL MONITORING RECORD	DATE:
Project No. / Project Name:	PAGE _____ of _____
Weather Conditions:	
Measuring Device: / Datum (MSL, NGVD, etc.):	
Observations/Comments:	

Well ID	Time	MP Elevation (ft.)	Depth to Product (ft. BMP)	Depth to Water (ft. BMP)	PSH Thickness (ft.)	Total Depth (ft. BMP)	Water Elevation (ft)	Remarks

Measured By:	**Pastor, Behling & Wheeler, LLC**
Checked By:	**2201 Double Creek Drive, Suite 4004**
	Round Rock Texas
	Phone: (512) 671-3434 Fax: (512) 671-3446

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 10

WATER QUALITY SAMPLING

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during sampling of groundwater. Appropriate revisions may be made to accommodate site-specific conditions or project-specific protocols when they are approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Groundwater Sample Collection

Individual samples from wells should be collected as follows:

A. The depth to water and the thickness or presence of a Non-Aqueous Phase Liquid (NAPL) in a well should be measured using the procedures discussed in the PBW SOP No. 9 (Water Level, Immiscible Layer and Well Depth Measurement).

B. As appropriate based on project requirements, a low-flow purge method or "micopurge" method should be used for sample collection. Wells should be purged at a low pumping rate to minimize agitation of water in the well and minimize drawdown. The goal is to limit drawdown in the well to less than 10 percent of the length of the saturated well screen. If the initial water level is above the top of the screen, then the goal is to limit drawdown due to purging so that the water level in the well does not drop below the top of the screened interval. Wells should be purged by pumping water at a rate less than 1 L per minute using a peristaltic pump. Bailers will not be used for purging of sampling wells. If during low-flow sampling the turbidity remains greater than 10 NTUs, the discharge from the pump will be filtered with an in-line 10 μm filter during sample collection. The in-line filter will be purged with approximately 200 mL of sample water before the laboratory container is filled.

C. At each well, the sample should be collected through a section of new, clean, flexible tubing.

D. For sampling active hydrocarbon recovery systems, the recovery pumps should be pulled from the well before sampling.

E. The sampling intake should be placed near the center of the well's screened interval or deeper if this reduces the chance of pumping LNAPL while purging the well.

F. Prior to collecting samples from a well, a clean plastic apron may be placed adjacent to or around the well to prevent equipment and sample containers from coming into contact with surface materials. Alternatively, a clean field table may be set up near the well. If used, the table will be cleaned before and after use at each well.

G. Sample containers prepared specifically for the required analyses by the analytical laboratory or their supplier should be used for sample collection. Glass sample bottles for non-volatile analyses should be filled to near the top. To account for slight expansion due to temperature changes, leave headspace approximately equivalent to the volume of liquid that would fill the bottle's cap. Plastic sample bottles should be filled completely. Splashing of the water in the sample container and exposure to the atmosphere should be minimized during sampling. The container cap should be screwed on tightly immediately after filling the sample container.

   Sample bottles that <u>do not</u> contain preservative should be rinsed with the sample water prior to filling.

H. Where more than one well within a specific field or site is to be sampled, the sampling sequence should begin with the well having the lowest suspected level of contamination. Successive samples should be obtained from wells with increasing suspected contamination. If the relative degree of suspected contamination at each well cannot be reasonably assumed, sampling should proceed from the perimeter of the site towards the center of the site. The sampling sequence should be arranged such that wells are sampled in order of increasing proximity to the suspected source of contamination, starting from the wells up-gradient of the suspected source.

I. Sampling activity for each monitoring well should be recorded on a Groundwater Sampling Record (Figure SOP-10-1).

2.2 Sample Filtration

When a filtered surface water sample is required, a sample should be collected using a disposable, in-line 0.45 μm filter. The water sample will be pumped through the filter using a peristaltic pump and a section of polyvinylchloride tubing or other appropriate method. An aliquot of approximately 200 ml of sample will be run through the tubing and filter prior to collection into the sampling containers. Both the filter and tubing will be disposed of between samples.

2.3 Sample Containers and Volumes

Sample containers and volumes should be selected based on the target analytical suite for each sample.

2.4 Sample Labeling

Sample containers will be labeled with self-adhesive tags. Each sample will be labeled with the following information using waterproof ink.

A. Project identification;

B. Sample identification;

C. Date and time samples were obtained;

D. Requested analyses and method;

E. Treatment (preservative added, filtered, etc.); and

F. Initials of sample collector(s).

2.5 Sample Preservation and Storage

As required based on the target analytes, water samples submitted for chemical analysis should be stored at 4° C in ice-cooled, insulated containers immediately after collection. The samples may be delivered to the laboratory soon after they are collected, in which case the water samples may not have had sufficient time to cool to 4° C. In these

instances, the samples will be considered properly preserved as long as they were placed on ice immediately after they were collected.

2.6 Sample Custody

Samples should be handled and transported according to the sample custody procedures discussed in PBW SOP No. 6 entitled Sample Custody, Packaging, and Shipment. The sample collector shall document each sample on the Chain-of-Custody and Request for Analysis form (Figure SOP-6-1).

2.7 Field Measurements

Specific conductance, pH, temperature and turbidity measurements may be performed on water samples at the time of sample collection. Data obtained from these (or other) field water quality measurements will be recorded on the appropriate sampling records. Separate aliquots of water shall be used to make field measurements (i.e., sample containers for laboratory analysis shall not be reopened).

For groundwater samples, at least three field measurements should be taken during the course of micro-purging the well. If the parameters have not stabilized at that time, field measurements and purging will continue until two consecutive readings have stabilized to within the following limits:

- Temperature: +/-1° C
- pH: +/-0.1 pH units
- Specific conductance: +/-10%
- Turbidity: +/- 10%

The procedures for collecting the listed field parameters are discussed in the following sections.

2.7.1 Temperature Measurement

Temperature should be measured directly from the water source or from a separate sample aliquot. Temperature measurements should be made with a mercury-filled thermometer, bimetallic-element thermometer or electronic thermistor (usually included with the pH and/or conductivity meter). Measurements should be recorded in degrees Celsius (°C).

2.7.2 pH Measurement

A pH measurement should be made by dipping the probe directly into the water source or into a separate sample aliquot. The preferable method is to collect measurements through a flow-thru cell. Prior to measurement, the container in which the field parameter sample will be collected should be acclimated to the approximate temperature of the sample. This can be accomplished by immersing the container in water removed from a well during the purging process. The pH measurement should be made within a few minutes after collection of the field parameter sample using a pH electrode. The value displayed on the calibrated instrument should be recorded after the reading has stabilized. If the value falls outside of the calibrated range, then the pH meter should be recalibrated using the appropriate buffer solutions.

2.7.3 Specific Conductance Measurement

Specific conductance should be measured by dipping the probe directly into the water source or into a separate sample aliquot. The probe must be immersed to the manufacturer's recommended depth. Specific conductance is reported in micromhos/cm at 25° C.

The value displayed on the calibrated instrument should be recorded after the reading has stabilized. If the value falls outside of the calibrated "range" set by the range dial on the instrument, then the range setting should be changed to a position that gives maximum definition. If the specific conductance value falls outside of the calibrated range of the

conductivity standard solution, then the instrument should be recalibrated using the appropriate standard prior to measurement.

2.7.4 Turbidity

The turbidity meter will be operated according to the manufacturer's instructions. Turbidity measurements are taken in nephelometric turbidity units (NTUs), which are generally read to the nearest 0.1 NTUs, if possible. When using a turbidimeter, make sure the glass sample vial is very clean, does not have condensation on it, and that there are few, if any, air bubbles present in the sample. These factors can all interfere with turbidity readings. In addition, if soluble compounds in the sample begin to precipitate out of solution (e.g., dissolved iron or manganese), then the turbidity measurements may be artificially high. If a turbidimeter is not available, turbidity can be measured qualitatively by indicating whether the sample has very little turbidity, moderate turbidity or is very turbid, or by a similar descriptive method. Keep in mind that this is a subjective and qualitative way to measure turbidity.

2.7.5 Equipment Calibration

Equipment used to measure field parameters should be calibrated by PBW personnel according to manufacturer's instructions. Calibration checks should be performed at least once prior to and at least once following each day of instrument use in the field and the results should be documented on the Sampling Record for each sampling station.

3.0 DOCUMENTATION

When the sampling activity is completed, the sampling records (Groundwater Sampling Record (Figure SOP-10-1) or Surface Water Sampling Record (Figure SOP-10-2)) should be checked by the PBW Project Manager or his/her designee, and the original record placed in the PBW project file. The following sections discuss the information that should be documented during groundwater or surface water sampling activities.

3.1 Groundwater Sampling Record

Each sampling event for each monitoring well will be recorded on a separate Groundwater Sampling Record form (Figure SOP-10-1). The documentation should include the following:

A. Project identification;

B. Location identification;

C. Sample identification(s) (including quality control samples);

D. Date and time of sampling;

E. Purging and sampling methods;

F. Sampling depth;

G. Name(s) of sample collector(s);

H. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

I. Total volume of water purged;

J. Results of field measurements and observations (time and cumulative purge volume, temperature, pH, specific conductance, turbidity, sediment, color, purge rate);

K. Equipment cleaning record;

L. Description and identification of field instruments and equipment; and

M. Equipment calibration record.

3.2 Surface Water Sampling Record

Activities for each surface water sample collected will be recorded on a separate Surface Water Sampling Record form (Figure SOP-10-2). The documentation should include the following:

A. Project identification;

B. Name(s) of sample collector(s);

C. Weather conditions (current and previous 48 hours);

D. Location identification and type of water body;

E. Sample identification(s) (including quality control samples);

F. Date and time of sampling;

G. Sampling methods;

H. Size, configuration of the water body sampled;

I. Flow estimates, if necessary;

J. Sampling depth, depth of water body;

K. Results of field measurements and observations (time, temperature, pH, specific conductance, turbidity, suspended sediment, color; conductivity/salinity, etc.);

L. Inventory of sample bottles collected including sample preservation (if any), number, and types of sample bottles;

M. Total volume of water purged;

N. Equipment cleaning record;

O. Description and identification of field instruments and equipment; and

P. Equipment calibration record.

4.0 QUALITY CONTROL

4.1 Chain-of-Custody and Request for Analysis Form

A Chain-of-Custody and Request for Analysis form (CC/RA form) should be filled out as described in PBW SOP No. 6.

4.2 Equipment Cleaning

Sample bottles and bottle caps should be cleaned and prepared by the analytical laboratory or their supplier using standard EPA-approved protocols. Sample bottles and

bottle caps will be protected from dust or other contamination between time of receipt by PBW and time of actual usage at the sampling site.

4.3 Records Review

The PBW Project Manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

FIGURE SOP-10-1. GROUNDWATER SAMPLING RECORD

GROUNDWATER SAMPLING RECORD

PAGE _____ of _____

Project Number: Project Name: Date:

Sample Number: Starting Water Level (ft. BMP): _____

Sampling Location (well ID, etc.): Casing Stickup (ft.): _____

Sampled by: Starting Water Level (ft. BGL): _____

Measuring Point (MP) of Well: Total Depth (ft. BGL): _____

Screened Interval (ft. BGL): Casing Diameter (In ID): _____

Filter Pack Interval (ft. BGL): Casing Volume (gal.):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment:

Purging: _____ Sampling: _____

Disposal of Discharged Water:

INSTRUMENTS (Indicate make, model, I.d.)

Water Level: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Filter / Filter Size: Other:

SAMPLING MEASUREMENTS

Time	Cum. Vol. (gal. or L)	Purge Rate (gal. or L /m)	Temp. (oC)	pH	Spec. Cond. (mmhos/cm)	D.O.	Redox (mV)	Turbidity & Color	Water Depth (ft BMP)

Water Level (ft. BMP) at End of Purge: Sample Intake Depth (ft. BMP):

SAMPLE INVENTORY

Bottles Collected				Filtration	Preservation	Remarks
Time	Volume	Composition (G, P)	No.	(Y / N)		(quality control sample, other)

Comments:

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FIGURE SOP-10-2. SURFACE WATER SAMPLING FORM

SURFACE WATER SAMPLING RECORD

SAMPLE NUMBER:

Project No:_____ Project Name:_____ Page _____ of: _____

Sampled by _____ Date: _____

Weather (@ sampling): _____ Weather (past 48 hrs.) _____

Sampling Location (i.d., description): _____

Water Body (describe type, flow):

QUALITY ASSURANCE

METHODS (describe):

Cleaning Equipment: _____

Sampling:_____

INSTRUMENTS (indicate make, model, i.d.):

Flow Measurement: _____ Thermometer: _____

pH Meter: _____ Field Calibration: _____

Conductivity Meter: _____ Field Calibration: _____

Filtration: Other:

SAMPLING MEASUREMENTS

Time	Sampling Depth (ft.)	Water Quality Data				Appearance		Remarks (debris, sheen, etc.)
		Temp. (°C)	pH	Specific Conductance (µmhos/cm)		Color	Turbidity & Sediment	
				@ Field Temp.	@ 25° C.			

Flow @ Sampling Point (units): Total Depth @ Sampling Point (Ft.):

SAMPLE INVENTORY

Bottles Collected				Filtration (Y/N)	Preservation (type)	Remarks (quality control sample, other)
Time	Volume	Composition (glass, plastic)	Quantity			

SAMPLING LOCATION MAP

(ref. permanent landmarks, indicate scale, approx. North, flow)

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STANDARD OPERATING PROCEDURE No. 11

FIELD MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL (ORP)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of oxidation-reduction potential in water samples. If necessary to accommodate specific field conditions, modifications of these procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Explanation of Method

The potential difference measured between an indicator electrode and a reference electrode in a water sample is the oxidation-reduction potential (ORP) of the water. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode.

The oxidation-reduction potential of water samples is most commonly reported relative to the standard hydrogen electrode, as Eh. Therefore, the oxidation-reduction potential of a water sample measured using a platinum indicator electrode and reference electrode must be corrected for the half-cell potential of the reference electrode in order to provide an Eh estimate for the water.

2.2 Instrumentation and Equipment

Typically, measurement of ORP requires the following equipment:

1. pH meter reading millivolts **OR** ORP meter such as Orion Model 98-75

2. Combination ORP electrode (Pt electrode with reference electrode) **OR** Reference electrode[1] (calomel or Ag/AgCl) and platinum electrode

3. Reference electrode filling solution, as required for some combination ORP electrodes[2]

4. Calibration standard (Zobell or Light's solution)

5. Clean (e.g., deionized) water for probe cleaning

6. Squeeze bottle for clean water

7. Clean container for sample water during measurement

8. Electrode cleaning solution

2.3 Instrument Checks

It is not possible to calibrate ORP electrodes over a range of conditions. Instead, standard solutions of known redox potential for specific indicator electrodes (i.e., Pt electrode) are used to check the electrode response at the temperature of measurement. Calibration checks should be performed and recorded on the Eh Data Sheet (Figure SOP-11-1) prior to each sample measurement as follows:

1. Assemble meter with either combination ORP electrode or set of platinum and reference electrodes.

2. If needed, select appropriate filling solution and fill reference electrode with fresh solution.

3. Place standard solution in clean container.

4. Measure and record temperature of standard solution (T_1) in degrees C.

5. For Zobell's solution, calculate the theoretical potential at the measured temperature using the following equation:

$$Eh_{(Zobell)} = 428 + 2.2*(25 - T) = \_\_\_\_\_ mV$$

---

1 The reference electrode and the filling solution must be recorded with ORP measurements.

2 If a combination ORP electrode is used, it may be possible to select the appropriate electrolyte filling solution for the reference electrode. For sample waters of low ionic strength (< 10,000 mg/L TDS), use the filling solution that matches the potential of a calomel electrode. For higher ionic strength waters (> 10,000 mg/L TDS), use 4N KCl saturated with Ag/AgCl.

6. For Light's solution, the theoretical potential at 25°C is **675 mV**. *(note: no temperature correction data available for Light's solution)*

7. Measure and record the potential of the standard solution in mV.

8. Correct the measured potential of Zobell's solution for the half-cell potential of the reference electrode using the potential of the reference electrode for the temperature of measurement (T_1) given in Table 1 below.

$$Eh_{(Standard)} = E_{(Standard),\ observed} + E_{(ref.\ electrode),\ at\ T_I} = \_\_\_\_\_ mV$$

Table 1. Half-Cell Potential of Reference Electrode at T

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251 mV	214 mV
20	244 mV	204 mV
25	241 mV	199 mV
30	238 mV	194 mV

9. Compare the corrected, measured potential of the standard solution (step 8) to the theoretical potential at the measured temperature (calculated in step 5 or 6). If the values are more than ±10 mV different, the meter and electrode functions should be checked as follows:

   (a) recheck temperature of standard solution
   (b) replace electrode filling solution
   (c) clean electrodes (refer to Section 4.1)
   (d) replace standard with new mix of solution

   Note: If the temperature of the standard solution is much higher or lower than 25°C (i.e., ± 15 degrees C), then the half-cell potential of the reference electrode may deviate significantly from the values given in Table 1. In this case, the proper function of the ORP measurement system cannot be verified.

   Alternate procedures are available to check the function of the ORP measurement system but require two reference electrodes, one that is known to be functioning properly. Refer to APHA Method 4500-H, Section 5.b. for a description of the alternate procedures.

10. Check initial measurement of standard solution. Measurements should agree within 10 mV. If the measurements do not agree, the meter and electrode functions should be checked as described in step 9.

2.4 Sample Measurement

After measurement of the standard solution confirms the electrode function, measure the redox potential of the water sample as follows:

1. Thoroughly clean the outside of the electrode(s) with deionized water prior to introducing to the sample water.

2. Measure and record sample temperature (T_2) in degrees C.

   Note: If the sample temperature is more than approximately 10 degrees C higher or lower than the temperature of the standard solution previously measured, the sample measurement may require additional time to stabilize due to drift in the reference electrode potential. Efforts should be made to maintain the standard solution at approximately the same temperature as the sample waters to be measured.

3. Immerse the ORP electrode(s) in the sample water.

4. Wait 2 minutes and then record the measured potential in mV.

5. Correct the measured potential of the sample solution for the half-cell potential of the reference electrode at the temperature of measurement (T_2) (refer to Table 1):

$$Eh_{(Sample)} = E_{(Sample),\ observed} + Eh_{(ref.\ electrode),\ at\ T_2} = \_\_\_\_\_\ mV$$

These steps must be documented on the attached Eh Data Sheet for each sample measurement.

2.5 Documentation and Record Management

Calibration information should be recorded on the Eh Data Sheet. ORP measurements will also be recorded on the Eh Data Sheet (Data Record, page 2 of 2) with associated calculations to compute Eh from ORP measurements. ORP measurements should not be reported as Eh data without first performing the correction calculations.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

3.1 Electrode Maintenance and Storage

Contamination of the electrode surface, salt bridge, or internal electrolyte solution in the case of reference electrodes can lead to excessive drift, poor electrode response, and artifact potentials (electrode "poisoning").

3.2 Routine Maintenance for Intermittent Use

The reference electrode should be cleaned for storage following each series of measurements or daily, as follows:

> Empty reference electrode of filling solution and rinse thoroughly with distilled water. The electrode should be stored filled with distilled water and should be labeled as so. If salt deposits have formed on the outside of the electrode casing, clean with a dilute acid or detergent solution and rinse thoroughly with distilled water.

The Pt indicator electrode should be cleaned daily by rinsing with distilled water and should be stored in distilled water between uses.

3.3 Long-term Maintenance

Follow manufacturer's instructions for long-term maintenance, cleaning and rejuvenation of electrodes. If excessive drift occurs or erratic performance of electrodes is observed in a standard solution after appropriate cleaning, refilling or regeneration procedures, discard the faulty electrode and use a new one.

3.4 Records Review

Calculations should be checked before any ORP or Eh data are reported for use on a project. The calculation check should be documented by the reviewer's initials and date of review on the Eh Data Sheet.

4.0 REFERENCES

American Public Health Association (APHA), 1995. *Standard Methods for the Examination of Water and Wastewater, 19th Edition.* Published by APHA, American Water Works Association, and Water Environment Association.

American Society for Testing and Materials (ASTM), 1993. *Standard Practice for Oxidation-Reduction Potential of Water, D-1498-93.*

Orion Research, Inc., 1983. *Instruction Manual for Platinum Redox Electrodes.*

USGS, 1976. *Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents.* Techniques of Water-Resources Investigations, Book 1, Chapter D2.Eh DATA SHEET.

Eh DATA SHEET

DATE:
LOCATION:

Project Number:	Project Name:	Sample No.
Sampler(s):		
Meter (Model No.):	Reference Electrode:	Filling Solution:

Standard: Zobell _____ Date Mixed: _____ (Discard after 6 months)
Light's _____

MEASUREMENTS/CALCUATIONS

A) Temperature of Standard Solution, T_1 (°C)

B) $Eh_{Standard;}$ theoretical
For Zobell: $Eh_{Zobell;}$ theoretical = 428 + 2.2 (25 – T) (mV)
For Light's: $Eh_{Lights;}$ theoretical = 675 mV

C) $E_{(Standard);}$ measured (mV)

D) $Eh_{(ref.\ electrode)}$ at T_1 (mV) for the appropriate reference electrode

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251	214
20	244	204
25	241	199
30	238	194

E) $Eh_{(Standard)} = E_{(standard);}$ measured + $E_{(ref.\ electrode)}$ (mV) E = C + D

F) Difference between theoretical and measured Eh of standard

$Eh_{(standard);}$ theoretical – $Eh_{(standard)} > \pm$ 10 mV? B – E > ± 10 mV?

If yes, then: 1) check temperature
2) replace electrode filling solution
3) replace standard

G) Temperature of sample, T_2 (°C)

H) $E_{(Sample);}$ measured (mV)

I) $Eh_{(ref.\ electrode)}$ at T_2 for the appropriate reference electrode

Temperature (°C)	Calomel	4N KCl saturated Ag/AgCl
10	251	214
20	244	204
25	241	199
30	238	194

J) $Eh_{(Sample)} = E_{(Sample)} + Eh_{(ref.\ electrode)}$ (mV) J = H + I

REFERENCES:
D1498.

1. American Society for Testing and Materials (ASTM), 1981. Standard Practice for Oxidation-Reduction Potential of Water,
2. Orion Research, Inc, 1982. Instruction Manual for Platinum Redox Electrodes.
3. USGS, 1976. Guidelines for Collection and Field Analysis of Ground-Water Samples for Selected Unstable Constituents. Techniques of Water-Resources Investigations, Book 1, Chapter D2.

DATA RECORD

Date	Time	Location or Sample	T_1 (°C)	$Eh_{(standard)}$ (mV)	$E_{(standard)}$ (mV)	$Eh_{(ref. electrode)}$ (mV)	$Eh_{(standard)}$ (mV)	Check value (mV)	T_2 (°C)	$E_{(sample)}$ (mV	$Eh_{(ref. electrode)}$ (mV)	$Eh_{(sample)}$ (mV)
			A	B	C	D	E (=C+D)	F (=B-E)	G	H	I	J (=H+I)
8/15/02	1500	Example 1	10°C	461	240	214	454	7	12°C	150	214	+364mV

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STANDARD OPERATING PROCEDURE No. 12

FIELD MEASUREMENT OF DISSOLVED OXYGEN (DO)

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the field measurement of dissolved oxygen in water samples. If necessary to accommodate specific field conditions, modifications to the procedure may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Explanation of Dissolved Oxygen and Methodology

Dissolved oxygen (DO) refers to the volume of oxygen that is contained in water. Oxygen enters the water by photosynthesis of aquatic biota and by the transfer of oxygen across the air-water interface. The amount of oxygen that can be held by the water depends on the water temperature, salinity, and pressure. Gas solubility increases with decreasing temperature (i.e., colder water holds more oxygen). Gas solubility increases with decreasing salinity (i.e., freshwater holds more oxygen than does saltwater). Both the partial pressure and the degree of saturation of oxygen will change with altitude. Finally, gas solubility decreases as pressure decreases. Thus, the amount of oxygen in water decreases as altitude increases because of the decrease in relative pressure.

Flowing water is more likely to have high dissolved oxygen levels than stagnant water because of the water movement at the air-water interface. In flowing water, oxygen-rich water at the surface is constantly being replaced by water containing less oxygen as a result of turbulence, creating a greater potential for exchange of oxygen across the air-water interface. Because stagnant water undergoes less internal mixing, the upper layer of oxygen-rich water tends to stay at the surface, resulting in lower dissolved oxygen levels throughout the water column. Oxygen losses readily occur when water temperatures rise, when plants and animals respire, and when microbes aerobically decompose organic matter.

The Membrane Electrode Method (such as that used on the YSI Model 55) is ideal for field dissolved oxygen (DO) testing. Polarographic or galvanic oxygen-sensitive membrane electrodes are composed of two metal electrodes in contact with a supporting electrolyte that is separated from the test solution by a selective membrane. Indicator electrodes are typically made of platinum and reference electrodes are commonly either calomel or Ag/AgCl electrodes with a KCl electrolyte solution. The reference electrode provides a constant electrode potential for comparison to the potential at the platinum electrode. A thin permeable membrane, stretched over the sensor, isolates the electrodes from the environment while allowing gases to enter. When a polarizing voltage is applied to the sensor electrodes oxygen, which has passed through the membrane, reacts at the cathode causing a current flow. The membrane passes oxygen at a rate proportional to the pressure difference across it. Since oxygen is rapidly consumed at the cathode, it can be assumed that the oxygen pressure inside the membrane is zero. Hence, the force causing the oxygen to diffuse through the membrane is proportional to the partial pressure of oxygen outside the membrane. As oxygen partial pressure varies, so does the oxygen diffusion through the membrane. This causes the probe current to change proportionally.

2.2 Instrumentation and Equipment

Typically, obtaining a field DO measurement requires the following equipment:

1. Membrane Electrode-type Dissolved Oxygen meter
2. Platinum indicator electrode and reference electrodes of either calomel or Ag/AgCl
3. KCl reference electrode filling solution
4. Clean (e.g., deionized) water for probe cleaning
5. Squeeze bottle of clean water
6. Membrane/O-ring & KCl kit for probe cleaning and replacement

2.3 Instrument Checks and Calibration

2.3.1 Probe Operation and Precautions

Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes,

or from large (more than ½ inch dia.) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, replace the membrane and the KCl solution. The average replacement interval is two to four weeks.

1. If the membrane is coated with oxygen consuming material (e.g., bacteria) or oxygen evolving organisms (e.g., algae), erroneous readings may occur.

2. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the probe. If you suspect erroneous readings, it may be necessary to determine if these gases are present.

3. Avoid any environment that contains substances that may attack the probe materials. Examples of some of these substances are concentrated acids, caustics, and strong solvents. Probe materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the polyurethane cable covering.

4. For correct probe operation, the gold cathode must always be bright. If it is tarnished, which can result from contact with certain gases, or plated with silver, which can result from extended use with a loose or wrinkled membrane, the gold surface must be restored. To restore the cathode you may either return the instrument to the factory, or clean it using a meter-specific reconditioning kit. Never use chemicals or abrasives not supplied with the kits.

5. It is also possible for the silver anode to become contaminated, which will prevent successful calibration. To clean the anode, remove the O-ring and membrane and soak the probe overnight in a 3% ammonium hydroxide solution. Next, rinse the sensor tip and KCl reservoir with deionized water, add new KCl solution, and install a new membrane and O-ring. Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are unable to calibrate, return the instrument to the manufacturer for service.

6. If the sensor O-ring is worn or loose, replace it with an appropriate O-ring.

7. To keep the electrode from drying out, store the probe in the instrument calibration chamber with a small piece of moist towel or sponge.

8. Consult the operations manual of the electrode instrument for the correct, instrument-specific calibration procedure.

2.4 Sample Measurement Procedures for Groundwater

Dissolved oxygen measurements should be taken during well purging and immediately before and after sample acquisition using a direct-reading meter. Because most well purging techniques allow aeration of collected groundwater samples, it is important to minimize potential aeration by taking the following precautions.

1) Purge well with a peristaltic pump to prevent downhole aeration of the sample in wells screened across the water table. Well drawdown should be kept to a minimum as described in PBW SOP No. 10 entitled (Water Quality Sampling). The pump tubing should be immersed alongside the dissolved oxygen probe beneath the water level in the sampling container (i.e., a flow-through cell). This will minimize aeration and keep water flowing past the dissolved oxygen probe's sampling membrane. If bubbles are observed in the tubing during purging, the flow rate of the pump must be slowed.

2) Dissolved oxygen measurements can be used as a stabilizing parameter in conjunction with other indicator parameters (i.e., pH, temperature, conductivity, etc.) to distinguish between formation water and stagnant casing water. Once these parameters have stabilized (typically ± 10% for DO), a representative DO measurement can be recorded from the in-line flow cell. Of the stabilization indicator parameters used above, DO usually requires the longest time for stabilization.

2.5 Documentation

All measurement results should be recorded according to procedures outlined in PBW SOP No. 1 entitled Field Documentation. The instrument manufacturer, model number and unique identification number should also be recorded with the measurement data.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

Field measurements will be reviewed prior to their use on a project. The project manager or designated reviewer should verify the DO data and also confirm that documentation has been completed per this procedure.

4.0 REFERENCES

EPA, 1995. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.

YSI Inc., 1994. Operations Manual for YSI Model 55 Handheld Dissolved Oxygen System (Membrane Electrode Instrument).

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 13

EQUIPMENT DECONTAMINATION

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the methods to be used for the decontamination of reusable field equipment that could become contaminated during use or during sampling. The equipment may include split spoons, bailers, trowels, shovels, hand augers or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution. It prevents cross contamination between samples and also helps to maintain a clean working environment.

Decontamination is achieved mainly by rinsing with liquids which may include: soap and/or detergent solutions, tap water, distilled weak acid solution, and/or methanol or other solvent. Equipment may be allowed to air dry after being cleaned or may be wiped dry with chemical-free towels or paper towels if immediate re-use is necessary.

At most project sites, decontamination of equipment that is re-used between sampling locations will be accomplished between each sample collection point. Waste produced by decontamination procedures, including waste liquids, solids, rags, gloves, etc., should be collected and disposed of properly, based upon the nature of contamination. Specific details for the handling of decontamination wastes are addressed in PBW SOP No. 14 entitled Storage and Disposal of Soil, Drilling Fluids and Water Generated During Field Work or may be specified by a project plan.

2.0 PROCEDURES

2.1 Responsibilities

It is the responsibility of the field supervisor to ensure that proper decontamination procedures are followed and that all waste materials produced by decontamination are properly managed. It is the responsibility of the project safety officer to draft and enforce safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the Site-Specific Health and Safety Plan. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and ensure that any contaminants are not negligently introduced to the environment.

2.2 Supporting Materials

1. Cleaning liquids: soap and/or detergent solutions (Alconox, etc.), tap water, distilled water, methanol, weak nitric acid solution, etc.
2. Personal protective safety gear as defined in the Site-Specific Health and Safety Plan.
3. Chemical-free towels or paper towels.
4. Disposable, nitrile gloves.
5. Waste storage containers: drums, boxes, plastic bags, etc.
6. Cleaning containers: plastic and/or stainless steel pans and buckets.
7. Cleaning brushes.
8. Aluminum foil.

2.3 Methods

The extent of known contamination will determine the degree of decontamination required. If the extent of contamination cannot be readily determined, cleaning should be done according to the assumption that the equipment is highly contaminated. Decontamination procedures should account for the types of contaminants known or suspected to be present. In general, high levels of organic contaminants may include an organic solvent wash step, and high levels of metals contamination may include a weak acid rinse step.

The procedures listed below constitute the full field decontamination procedure. If different or more elaborate procedures are required for a specific project, they may be specified in sampling and analysis or work plan. Such variations in decontamination protocols may include all, part or an expanded scope of the decontamination procedure stated herein.

1. Remove gross contamination from the equipment by dry brushing, and rinse with tap water.

2. Wash with soap or laboratory-grade detergent solution.

3. Rinse with tap water.

4. Rinse with methanol (optional, for equipment contaminated by organic compounds).

5. Rinse with acid solution (optional, for equipment contaminated by metals).

6. Rinse with distilled or deionized water.

7. Repeat entire procedure or any parts of the procedure as necessary.

8. Air dry.

As appropriate, decontaminated equipment should be stored in sealable containers, such as Ziplock-type plastic bags or cases or boxes with lids.

3.0 DOCUMENTATION

Field notes will be kept describing the decontamination procedures followed. The field notes will be recorded according to procedures described in PBW SOP No. 1 entitled Field Documentation.

4.0 QUALITY CONTROL

To assess the adequacy of decontamination procedures, field rinsate blanks may be collected. The specific number of rinsate blanks will be defined in a sampling and analysis or work plan or by the PBW project manager. In general, at least one field rinsate blank should be collected per sampling event or per day.

Rinsate blanks with elevated or detected contaminants should be evaluated by the Project Manager, who will relay the results to the site workers. Such results may be indicative of inadequate decontamination procedures that require corrective actions (e.g., retraining).

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 14

STORAGE AND DISPOSAL OF SOIL, DRILLING FLUIDS, AND WATER GENERATED DURING FIELD WORK

1.0 SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed for the storage, testing, and disposal of soil, drilling fluids, and water generated during any field operations performed by PBW. The procedures presented herein are intended to be of a general nature. Appropriate modifications to the procedures may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Material Storage and Labeling

Potentially-contaminated materials should be collected and stored in water-tight, secured containers pending determination of their hazards. The containers should be stored temporarily at the site of origin. All steel drums used for storage will be Department of Transportation (DOT)-approved, so that hazardous materials may be transported in these drums if necessary. A daily inventory of the materials generated and the containers in which they are stored should be recorded on the Daily Field Record form. The Daily Field Record is presented in PBW SOP No. 1 entitled Field Documentation.

2.2 Well Purging and Development Water

Water extracted from potentially-contaminated wells or piezometers for the purpose of development, sampling, or hydraulic testing should be stored in sealed, 55-gallon, steel drums or in portable, watertight storage tanks. The containers should be labeled with an indelible marking including the: date; well or piezometer number(s); and "development water" if the water was extracted for development or "purge water" if the water was extracted for sampling or hydraulic testing, in addition to the other labeling requirements included Section 3.0 of this SOP.

2.3 Drilling Fluid

As appropriate based on site data, drilling fluid generated by hydraulic rotary drilling operations may be either spread out on the site or stored in sealed, 55-gallon, steel drums or in portable, watertight storage tanks depending on the contaminant distribution, if any, at the site. The containers should be labeled with an indelible marking including the date; boring, well, or piezometer number(s); and "drilling fluid," in addition to the other labeling requirements included in Section 3.0 of this SOP.

2.4 Soil Cuttings

Soil cuttings generated by drilling operations should be stored in sealed, 55-gallon, steel drums or in soil boxes with roll-top, lockable covers. The containers should be labeled with an indelible marking including the: date; boring, well or piezometer number(s); and "cuttings," in addition to the other labeling requirements included in Section 3.0 of this SOP.

2.5 Wash Water

Water used to decontaminate equipment, by steam cleaning or other methods, that was used in potentially contaminated borings, wells or piezometers should be stored in sealed, 55-gallon steel drums or in portable, watertight storage tanks. The containers should be labeled with an indelible marking including the: date; boring, well or piezometer number(s); and "wash water," in addition to the other labeling requirements included Section 3.0 of this SOP.

2.6 Criteria for Hazard Determination

Analyses for hazard determination should be conducted by a laboratory certified by the applicable agency in the state in which the project site is located. Waste classification should be based on the criteria detailed in the applicable state and federal regulations.

2.6.1 Drilling Fluid and Cuttings from Exploratory Soil Borings and Well or Piezometer Installation

Evaluation of the hazard status for drilling fluid and cuttings from each boring, well or piezometer may be based upon the results of chemical analyses of the soil and groundwater samples collected from each boring, well or piezometer. Alternatively, representative samples of the drilling fluid and cuttings may be collected and analyzed.

2.6.2 Well Purging and Development Water

Evaluation of the hazard status for well purging and development water from each well or piezometer may be based upon the results of chemical analysis of the groundwater sample subsequently collected from each well or piezometer. Alternatively, representative samples of the purging and development water may be collected and analyzed.

2.7 Labeling

All drums containing waste should be labeled using self-adhesive labels placed on the side of the drums. The labels should be placed in a location on the drum such that the label can be easily read. At a minimum, the following information should be placed on the label using an indelible pen:

- Generator (client) name;
- Drum identification number (when more than one drum present);
- Description of contents, including boring, well or piezometer number(s), as appropriate;
- Date of generation;
- Technical contact (generally the name and phone number of PBW Project Manager); and
- PBW project number.

Local hazardous material storage regulations should also be reviewed for labeling requirements in addition to those listed above.

Appropriate hazardous waste labels should be used when analytical results indicate that the contents are hazardous waste.

2.8 Documentation

All of the information recorded on the drum labels should also be recorded in field notes completed at the work site. This information will be copied to the project file.

3.0 QUALITY CONTROL

3.1 Treatment and Disposal of Contaminated Materials

Soil, drilling fluid and water containing hazardous constituents should be treated and/or disposed of in accordance with all local, state and federal regulations. The appropriateness of on-site treatment versus off-site treatment and/or disposal should be evaluated by the PBW Project Manager based on the hazard determination.

3.2 On-Site Treatment of Contaminated Materials

Soil, drilling fluid, and water of known hazardous composition may be treated on-site provided: (1) such treatment is conducted in accordance with all local, state, and federal regulations based upon location, level of contamination, and volume of material; and (2) permission has been obtained as part of a site access agreement. On-site treatment may be feasible and economical if an on-site soil and/or groundwater treatment system is planned.

3.3 Transport and Disposal of Contaminated Materials

Hazardous waste that requires off-site disposal should be transported by certified hazardous material haulers to approved disposal sites in accordance with state and federal transportation regulations.

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 15

HYDRAULIC TESTING

1.0 . SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the protocol to be followed during performance of a constant-discharge pumping test or a "slug test." The procedures presented herein are intended to be general in nature; as the work progresses and when warranted, appropriate revisions may be made when approved by the PBW Project Manager.

2.0 PROCEDURES

2.1 Constant-Discharge Test

The performance of a constant-discharge pumping test involves three phases: 1) pre-test measurements; 2) pumping portion of the test; and 3) recovery portion of the test. Pre-test measurements include water level measurements which indicate water level trends in the test area. These effects must be accounted for when test data are analyzed. The pumping portion of the test involves monitoring water levels in the pumping well and observation wells while the discharge in the pumping well is kept fairly constant. Groundwater samples may be collected during this phase. The recovery portion of the test occurs after pumping is stopped and involves the measurement of recovery water levels in the pumped well and observation wells.

2.1.1 Pre-Test Measurements

2.1.1.1 Water Level Measurements

Prior to conducting a pumping test, water level measurements should be taken in the pumped well and all observation wells (other monitoring wells and piezometers) to be monitored during the test to describe the pre-test potentiometric surface and its natural variability (refer to PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement). Measurements in both the pumped well and observation wells should be taken at least every 4 hours for a minimum of three days before the pumping test begins. More frequent water level measurements in one or more wells using a continuous recording device may be used to substitute for the 4-hour measurement requirement in the pumped well and all observation wells.

Prior to beginning the pumping test, watches, the datalogger and other timing devices to be used in the test should be synchronized.

The water level measurements may be made with an electric water level probe, steel surveyors' tape or continuous recording device (Stevens recorder or pressure transducer/recorder). Accuracy of water level measurements prior to and during the aquifer test should be to within plus or minus 0.02-foot in the observation wells.

An observation well may be monitored continuously with a Stevens Type F water level recorder or a pressure transducer/recorder.

If water levels are measured by hand, all pre-test water level measurements for the pumping well and observation wells should be recorded on a Pumping Test Record form (Figure SOP-15-1). The same form should be used during the pumping portion of the pumping test.

2.1.1.2 Barometric Measurements

A record of barometric changes in the vicinity of the pumping test site should be obtained for the pre-test and test period. This record will be used to monitor changes in water levels caused by barometric effects. A recording barograph or record from a nearby weather station is acceptable.

2.1.2 Pumping Portion of Test

2.1.2.1 Measurements to be Taken

During the pumping portion of the pumping test, the following measurements should be made: 1) water levels in both the pumped well and the observation wells; 2) instantaneous and cumulative discharge from the pumped well; and 3) time at which these measurements are made. Samples of the discharge water may also be collected periodically during the test for chemical analysis or field testing. All should be recorded on the Pumping Test Record form (Figure SOP-15-1) for the appropriate well.

2.1.2.2 Water Levels

Pumped Well:

The water level measurements in the pumped well should be taken according to the time schedule outlined below. More or less frequent measurements may be used.

Time Since Pumping Started			Time Intervals
0	-	10 minutes	0.5- 1 minute
10	-	15 minutes	1 minutes
15	-	60 minutes	5 minutes
60	-	300minutes	30 minutes
300	-	1440 minutes	60 minutes
1440	-	shut down of pump	480 minutes (8 hours)

Observation Wells:

Stevens Type F continuous recorders or pressure transducer/datalogger may be installed in the observation wells. Water level measurements may be taken in these wells using an electric water level probe or steel surveyors' tape for calibration when the Stevens recorder or transducer/recorder is installed, and whenever the recorder chart paper is changed or the recorder is adjusted in any way. If a continuous recorder or pressure transducer/datalogger is not used, then water level measurements may be taken using an electric water level probe or steel surveyor's tape according to the following schedule:

Time Since Pumping Started			Time Intervals
0	-	60 minutes	1 minute
60	-	120 minutes	5 minutes
120	-	240 minutes	10 minutes
240	-	360 minutes	30 minutes
360	-	1440 minutes	60 minutes
1440	-	shut down of pump	480 minutes (8 hours)

The time of measurements and water level measurement should be entered in the appropriate columns of the Pumping Test Record form (Figure SOP-15-1) for the pumped well and observation wells. If a Stevens recorder or pressure transducer/recorder is used, water level calibration and pertinent notes should be entered on the Pumping Test Record form.

2.1.2.3 Discharge Rate

Discharge from the pumped well should be measured using either of the following methods: 1) totalizing flow meter and stopwatch; 2) circular orifice meter; 3) Venturi meter; 4) Parshall flume; or 5) calibrated container and stopwatch. The discharge reading and time of reading should be entered on the Pumping Test Record form for the pumped well.

Discharge should be maintained within plus or minus 5 percent of the designated rate by means of a globe valve or other throttling device. Discharge should be checked and adjusted, if necessary, every 10 minutes during the first hour of pumping, at 30-minute intervals for the following 5 hours, and at one-hour intervals thereafter. Time of measurement and rate of discharge should be entered on the Pumping Test Record form for the pumped well (Figure SOP-15-1). If the pump is driven directly by an engine, the engine speed (in RPM) should be checked and noted every hour during the test. If the pump is run by an engine or a generator, the fuel level and the oil level in the engine or generator should be checked periodically, and fuel and/or lubricating oil added when necessary.

2.1.3 Sampling of Discharge Water

Samples of discharge water from the pumped well may be collected at time intervals specified by the Project Manager, provided such sampling does not interfere with water level measurements. The temperature, pH, and specific conductance of the samples may be measured in the field when the samples are collected. The samples should be preserved for subsequent chemical analysis by an authorized laboratory in accordance with PBW SOP No. 10 entitled Water Quality Sampling. The time the samples were collected and field measurements of water quality parameters should be recorded on the Pumping Test Record form (Figure SOP-15-1) for the pumped well.

2.1.4 Duration of Pumping

The target duration of the pumping portion of each pumping test should be established prior to beginning the test. During the test, time-drawdown and/or distance-drawdown curves for the observation wells may be plotted on semi-logarithmic paper to assist in evaluating if the test is running well and deciding on the time that the pump should be shut off. If the plots indicate steady-state conditions (e.g., the interception of a recharge source), the test may be ended before its target duration. The pumping portion of the test may be extended, at the discretion of the Project Manager, to evaluate hydrologic boundaries or other transient conditions.

2.1.5 Aborted Test

Failure of pumping operations for a period greater than one (1) percent of the elapsed pumping time may require suspension of the test until the water level measured in the pumped well has recovered to within two (2) percent of the total drawdown in the pumped well during pumping. Recovery in the pumped well should be considered complete after the well has not been stressed for a period at least equal to the elapsed pumping time of the aborted test, or if any three successive water level measurements, at least 30 minutes apart, show no further rise in the water level in the pumped well. When recovery is complete, the pumping portion of the test may be resumed.

2.1.6 Recovery Portion of Test

After the pumping portion of the test has been completed, the pump should be shut off. Water level measurements may then be taken in the pumped well and observation wells in accordance with the approximate schedule presented below:

Time Since Pumping Stopped			Time Intervals	
0	-	15 minutes	1	minute
15	-	60 minutes	5	minutes
60	-	300 minutes	30	minutes
300	-	1440minutes	60	minutes
1440	-	End of test	480	minutes (8 hours)

Water level measurements should continue in the pumped well and observation wells until the water level in the pumped well has recovered to its pre-pumping level, or until a length of time equal to the pumping period has elapsed.

The water level data (water level below MP) and time at which measurement is made for each well should be entered on a Pumping Test Record form (Figure SOP-15-1), using the columns for the recovery portion of the test.

2.1.7 Pump Discharge

The water discharged from the pumped well should be prevented from entering the water-yielding zone being tested. If concentrations of chemicals in the discharged water are suspected to be above regulatory limits for discharge to natural water courses, the water from the pumped well should be collected for appropriate treatment and/or disposal.

2.2 Slug Tests

Falling-head or rising-head tests ("slug tests") may be performed on piezometers and monitoring wells to estimate the lateral hydraulic conductivity of the water-bearing strata. Although the radius of influence (i.e., portion of the water-yielding zone tested) is smaller for a slug test than for long-term pumping tests, this testing method is often selected due to the low productivity and/or small available drawdown in wells. Another important consideration is that many locations can be evaluated with the slug test method for the same level of effort and cost of one pumping test.

2.2.1 Testing Equipment

A slug test consists of instantaneously raising or lowering the water level in a well and then monitoring the change of the water level through time. The slug tests should be performed by rapidly submerging (slug-in test) or retracting (slug-out test) a slug of known volume. A typical slug used in 2-inch wells is constructed of a sealed, 1-inch diameter, stainless steel pipe. The displacement volume of the slug should be measured prior to the test program.

A pressure transducer with an appropriate operating range should be used to measure the water levels during the slug tests. The pressure readings should be recorded and converted to feet of water above the transducer using a datalogger. The datalogger should be programmed to record the water levels at one-second intervals at the beginning of a test and to logarithmically increase the sampling interval to several minutes toward the end of the test.

2.2.2 Testing Procedure

Upon arrival at a test well site, the static water level and total depth of the well should be measured with an electric water level probe or steel surveyors' tape (see PBW SOP No. 9 entitled Water Level, Immiscible Layer and Well Depth Measurement). The pressure transducer is then secured in the well to a depth below the lowest point to which the slug will be lowered. Before starting the test, sufficient time should be allowed for the water level in the well to adjust to the displacement caused by the transducer and cable, and for the transducer to equilibrate to the water temperature. During this period, the water level in the well should be monitored electronically using the datalogger and measured periodically with the electric water level probe or steel surveyors' tape to confirm that static water level conditions exist. Next, the

slug should be lowered to a point just above the water level in the well and then rapidly submerged to begin the test.

As data are collected, the water levels displayed by the datalogger should be examined to monitor trends and the progress of the test. Manual water level measurements also should be taken during the test to confirm the transducer readings and documented on the Slug Test Form (Figure SOP-15-2). Each test should proceed until the water level attains at least 95 percent recovery from the slug displacement. Following completion of the slug-in test, a slug-out test should be performed by rapidly pulling the slug out of the water and monitoring the recovery of water level in the same manner as for the slug-in test. In some cases, more than one slug-in and/or slug-out test may be performed to provide additional confirmation of the results.

2.2.3 Equipment Decontamination

Prior to the first slug test and between each test, the slugs, transducer, cable and water level probe (or steel tape) should be decontaminated in accordance with PBW SOP No. 13 entitled Equipment Decontamination.

2.3 Data Analysis

2.3.1 Data Processing

The data collected by the datalogger are stored in the memory of the datalogger and then transferred to a cassette tape or to a computer in the field. If not transferred directly to a computer, these data are subsequently transferred to a computer for field data quality checks and data analysis. When transferred to computer, the data sets are transferred to files in comma-delineated ASCII format. The contents of each data file are imported to a spreadsheet program which allows the data manipulation and graphical presentation needed to calculate the hydraulic parameters of the water-yielding zone.

2.3.2 Slug Test Data Analysis

Slug tests in confined zones should be analyzed primarily by the method described by Cooper, Bredehoeft and Papadopulos (1967), whereas slug tests in semi-confined to unconfined water-yielding zones should be analyzed by the method discussed by Bouwer and Rice (1976). The Bouwer and Rice (1976) method is also applicable to confined aquifers and may be used to compare the results of the Cooper et al. (1967) method for confined aquifers.

Summary of Cooper, Bredehoeft and Papadopulos Method

Cooper et al. (1967) derived a solution using a partial differential equation for radial flow for the response of a finite-diameter well to an instantaneous "slug" of water. The method of analysis involves plotting the results of the slug test as H/H_o versus log t (time), where:

H = head inside the well above or below the initial head at time t after injection or removal of the slug.

H_o = head inside the well above or below the initial head at the instant of injection or removal of the slug.

The slug test plot is then compared against a set of "Type Curves" derived and published by Cooper et al. (1967) and Papadopulos, Bredehoeft and Cooper (1973), using a curve matching method, such that curves are moved parallel to H/H_o to match each other. When the best match between the data plot and type curves is obtained, a value of t is selected at the $Tt/r_c^2 = 1$ match point. The transmissivity (T) is then calculated using the following equation:

$$T = \frac{r_c^2}{t}$$

where: r_c = radius of the well casing.

The hydraulic conductivity (K) is obtained from the T value by:

$$K = \frac{T}{b}$$

where: b = thickness of water-yielding zone.

This method assumes that the water-yielding zone is homogeneous, isotropic, and of uniform thickness, and that the tested well is screened throughout the thickness of the water-yielding zone.

Summary of Bouwer and Rice Method

Bouwer and Rice (1976) presented a procedure for analysis of slug test data from an unconfined aquifer. Based on an electrical analog, Bouwer and Rice provided a convenient set of curves relating the effective radius (R_e) to the other well dimensions. This procedure is based on a modification of the Theim equation for steady state groundwater flow.

$$K = \frac{r_c^2 \ln(R_e / r_w)}{2L} \frac{1}{t} \ln \frac{Y_0}{Y_t}$$

where:

K	=	Hydraulic conductivity
L	=	Screen length
Y_o	=	Head of water at time (o)
Y_t	=	Head of water at time (t)
t	=	Time
r_c	=	Inside radius of casing
r_w	=	Radius of casing plus thickness of filter pack
R_e	=	Effective radius (value of R_e obtained from the set of curves given by Bouwer and Rice)

This method estimates the hydraulic conductivity without calculating transmissivity. The results of the slug tests are plotted as a semi-logarithmic graph of Y_t versus t. The values of Y_t, Y_o, and t are obtained from the straight-line portion of the graph, and the value of K is calculated.

If the water level fluctuates within the screened interval or below the base of the bentonite seal in the well, the following correction will be made to include the porosity of the filter pack in the cross-sectional area of the well (Bouwer and Rice (1976)):

$$r_c = \left\{r^2 + n\left(R^2 - r^2\right)\right\}^{0.5}$$

where:

r_c	=	radius of the well including estimated filter pack porosity
r	=	radius of the well screen
n	=	estimated porosity of the filter pack
R	=	radius of the bore hole

3.0 QUALITY ASSURANCE

3.1 Calculation Check

All data and calculations recorded on the Pumping Test Record should be reviewed prior to use. The reviewer should be a technically qualified hydrologist or hydrogeologist, as designated by the PBW Project Manager. Record of the calculation review should be made by the reviewer's initials and date of review on the original Pumping Test Record form.

3.2 Records Review

The project manager or designated QA reviewer should check and verify that documentation has been completed and filed per this procedure.

4.0 REFERENCES

Bouwer, Herman and R. C. Rice, 1976. *A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells.* Water Resources Research, Vol. 12, No. 3, pp. 423-428, June.

Bouwer, Herman, 1989 *The Bouwer and Rice Slug Test - An Update*: Ground Water, Vol. 27, No. 3, pp. 304-309, May-June.

Bouwer, Herman, 1989. *Discussion of "The Bouwer and Rice Slug Test - An Update*: Ground Water, Vol. 27, No. 5, pp. 715, September - October.

Cooper, Hilton H. (Jr.), John D. Bredehoeft, and Istavros S. Papadopulos, 1967. *Response of a Finite-diameter Well to an Instantaneous Charge of Water.* Water Resources Research, Vol. 3, No. 1, pp. 263-269.

Papadopulos, Istavros S., John D. Bredehoeft, and Hilton H. Cooper (Jr.), 1973, *On the Analysis of 'Slug Test' Data.* Water Resources Research, Vol. 9, No. 4, pp. 1087-1089, August.

FIGURE SOP-15-1. PUMPING TEST RECORD

PUMPING TEST RECORD

☐ OBSERVATION WELL _____
☐ PUMPING WELL _____

PAGE _____ OF _____

PROJECT AND LOCATION				PROJECT NO.	DATE
PUMPING WELL		OBSERVATION WELL		TIME STARTED	TIME FINISHED
RADIUS	DEPTH	DEPTH	DISTANCE (OBS TO PUMP)	MEASURING POINT (ELEV)	CASING HEIGHT
SCREEN INTERVAL		PUMP SETTING		DATALOGGER	
PUMP/ELECTRICAL EQUIPMENT				PERSONNEL	
COMMENTS					

			WATER LEVEL DATA			PUMPING DATA			WATER QUALITY			REMARKS
DATE AND TIME	TIME SINCE START OF PUMPING, t (MIN)	TIME SINCE PUMPING STOPPED , t' MIN)	WATER LEVEL BELOW MP (FEET)	DRAWDOWN, s (FEET)	RESIDUAL DRAWDOWN, s' (FEET)	PUMPING RATE) (GPM) (BY	CUMULATIVE DISCHARGE) (GAL) (BY	METER READING (GAL)	TEMPERATURE (°C)	pH	SPECIFIC CONDUCTANCE (umhos/cm)	

PASTOR, BEHLING & WHEELER, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664
(512) 671-3434
Fax (512) 671-3446

FIGURE SOP-15-2. SLUG TEST FORM

SLUG TEST FORM

Pastor, Behling & Wheeler, LLC
2201 Double Creek Drive, Suite 4004
Round Rock, Texas 78664
Phone: (512) 671-3434 Fax: (512) 671-3446

Date Tested:	Well No.:
Slug IN or OUT:	Measuring Point (MP):
Well Diameter (in.):	MP Height (ft. above ground level):

Well Depth (ft. BGL):	Slug Type (stainless, PVC, Teflon):
Screen Interval (ft. BGL):	Slug Length (ft.):
Starting WL (ft. BMP):	Slug Diameter (ft.):
Decon. Procedures:	Slug Volume (cu. ft.):
	Expected Well Response (+/- ft.):
Start Time: End Time:	Performed by:

Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)	Minutes Since Start	Water Level (ft. BMP)

Benchmark Ecological Services, Inc.
Standard Operating Procedures

SOP Number	Title	Revision Date
	Sediment Sampling	
SOP-BESI-101	Sediment Sampling Using a Ponar Grab, Ekman Grab or Equivalent Sampling Device for Saltwateror Freshwater Sediment	9/14/2003
SOP-BESI-102	Collecting Sediment Samples with a Piston Corer	9/14/2005
	Biota Sampling	
SOP-BESI-303	Collection of Finfish and Crabs Using Gill Nets	9/14/2003
SOP-BESI-304	Collection of Blue Crabs Using Commercial Crab Traps	9/14/2005
	Field Collection Instruments	
SOP-BESI-401	YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures	9/14/2005
SOP-BESI-402	YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation	9/14/2005
SOP-BESI-403	Locating and Recording Sample Stations Using a Trimble GEO XT Global Positioning System	9/14/2005
	Sample Processing & Handling	
SOP-BESI-502	Sample Shipping and Freezing Procedures	3/01/06
SOP-BESI-503	Compositing Sediment Samples	9/14/2005
SOP-BESI-506	Measuring Crab Carapace Width and Wet Weight	9/14/2005
SOP-BESI-507	Crab Tissue Processing	9/14/2005
SOP-BESI-508	Measuring Fish Length and Wet Weight	9/14/2005
SOP-BESI-509	Fish Tissue Processing	9/14/2005
SOP-BESI-600	Water Sampling via Peristaltic Pump	3/01/06
SOP-BESI-601	Decontamination of Tubing and Filters for Water Sampling	3/01/06

STANDARD OPERATING PROCEDURE
SOP-BESI-101

TITLE: Sediment Sampling Using a Ponar Grab, Ekman Grab or Equivalent Device

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

COLLECTING SEDIMENT SAMPLES WITH A PONAR GRAB, ECKMAN GRAB OR EQUIVALENT DEVICE

1.0 PURPOSE AND APPLICABILITY

This SOP describes the proper procedures for operating a sediment sampler to collect surficial sediment (0-6 inches deep), and handling sediment samples after collection. The purpose is to obtain surficial sediment samples using a Ponar Grab, Ekman Grab or equivalent sampling device.

2.0 DEFINITIONS

Surficial sediment – Material from the top layers of sediment. Sediment from the 0-6 inches layer are generally considered surficial. The depth to be sampled must be specified.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure to reduce exposure to contaminants that may be present in the water or sediment.

3.2 If volatile chemicals are expected in samples, respirators (with proper cartridge) must be worn.

3.3 Proper lifting techniques should be utilized when handling heavy objects.

3.4 General boat safety criteria should be practiced at all times, including awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and stations.

6.0 EQUIPMENT AND MATERIALS

- Ponar grab sampler
- Ekman grab sampler
- Messenger
- Rope or Stainless Steel Pole
- Tub (to receive filled sampler)
- Stainless steel bowl
- Stainless steel or Teflon® spoons
- Sample jars

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 A Ponar grab, Ekman grab (or equivalent) will be used to collect surficial sediments. Grab samplers generally have an open or screened top to allow water to pass through the sampler as it descends, reducing forward wake, which can disturb surface sediment. The grab sampler is attached to a low-stretch rope or stainless steel pole.

8.2 The clean sampler is placed in a clean tub or on another clean surface on the deck of the boat. If the sampler has a safety pin, it will be removed when the sampler is safely over the sample station. To prevent forward wake, the sampler should not descend faster than 0.2 m/sec when as it nears the bottom. If the sampling depth is shallow, the grab will be lowered at approximately 0.2 m/sec until it enters the sediment. In deep water, the descent can be faster but must be slowed to about 0.2 m/sec several meters before it enters the sediments. If sampler requires a trigger/messenger, attach messenger to the line and release.

8.3 Retrieval of the sampler, after it has settled into the sediment, must be slow to ensure proper closure of the jaws. The sampler should be retrieved at a speed of 0.3 m/sec. The sampler should be lifted slowly from the water and quickly secured to prevent swinging. Rapid retrieve or swinging may disturb surface sediments. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment sloshing.

8.4 A sample is acceptable if it is covered with water (indicates the sampler is not leaking), and surface sediment is relatively flat and undisturbed. Because of the action of the closing jaws, some samples may be flat and undisturbed only in the center. If a sample is not acceptable it should be set aside (do not dump overboard), and a second sample should be collected. Unacceptable samples can be discharged overboard after an acceptable sample is collected.

8.5 Samples may also be considered unsuitable if there is less than 6 inches of sediment in the sampler. If necessary, the sample station may be relocated and the change documented in the sample log.

8.6 If measurements are to be taken from water overlying the sediment sample, they must be taken before the sample is disturbed or overlying water must be collected for the measurements.

8.7 Prior to removing sediments from the sampler, the overlying water will be siphoned off with a piece of tubing, or the grab sampler will be drained by gently tilting it.

8.8 If sub-samples are needed, they may be collected from the top of the closed sampler using a spoon, scoop, or core tube. Sediment for chemical and biological analyses will be removed using pre-cleaned stainless steel spoons and composited using pre-cleaned stainless steel bowls. Only the sediment from the center of the grab sampler (i.e., no sediment touching the walls of the sampler) will be used.

8.9 The empty sampler should be rinsed and decontaminated using water and Alconox® or an

equivalent cleaning chemical, and rinsed with deionized water. The sampler and associated equipment is decontaminated before use and between sample sites. In addition, the sampler will be rinsed with site water before samples are collected. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment in order to reduce the chance of contaminating the sediment sample.

10.0 DOCUMENTATION

Document the water depth, sediment depth, basic sediment characteristics, station coordinates, sample time and processing time.

General descriptive information on the sediments and appropriate field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of sample, including texture, color, biological structures (e.g., shells, benthic infauna), debris (wood chips, human artifacts), odors (oil, gas, hydrogen sulfide),
- Approximate depth or aerobic and anaerobic sediment layers,
- Penetration depth of the sampler and/or general depth of sample taken (i.e., top 2 cm, 2-10 cm, etc.), and,
- Comments that relate to sample quality such as leakage, winnowing, disturbance.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

STANDARD OPERATING PROCEDURE
SOP-BESI-102

TITLE: Collecting Sediment Samples with a Piston Corer

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

COLLECTING SEDIMENT SAMPLES WITH A PISTON CORER

1.0 PURPOSE AND APPLICABILITY

To collect sediment samples with a piston corer in a safe and efficient way.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personnel from possible contaminants that may be present in the water or sediment.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

3.4 Respirators may be required when sampling sediment contaminated with toxic volatiles. Respirators must fit properly and the appropriate cartridges must be available.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and sample stations.

6.0 EQUIPMENT AND MATERIALS

- Piston corer head and rope
- Pistons (minimum of 2)
- Depth weight and rope
- Sufficient length of piston corer poles
- Wire-lock pins for the piston corer pole extensions
- Sufficient number of pre-cleaned core tubes
- Drill bit for punching holes in core tube
- Clamps for the core tube connection to the piston head (minimum of 2)
- Flat head screw driver or nut driver
- Core stoppers
- Nitrile gloves
- Safety glasses
- Paper towels
- Core tube brush

- Core tube cutter
- Measuring tape
- Alconox
- Global Positioning System (GPS)
- Data Sheets
- Sample Platform
- Extruding Device (if cuts are required)

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Site location and positioning

8.1.1 Sample personnel will locate sample stations using maps, GPS (SOP-BESI-403), and/or field markers.

8.1.2 Once sample stations have been identified in the field, the sampling platform may be held on station with the use of anchors, tying off to existing structures and/or the sample platform motor.

8.1.3 Mark and record the sample station with the GPS (SOP-BESI-403).

8.2 Collecting sediment with the piston corer (Figure 2)

8.2.1 Determine water depth from the sample platform to the surface of the sediment by lowering a weight from the sample platform. When the weight contacts the sediment surface the rope is calibrated by tying it off to the sample platform. Raise and remove the weight from the calibrated rope.

8.2.2 Insert piston rope through a pre-cleaned core tube and connect piston to rope.

8.2.3 Attach core head to core tube using at least one clamp.

8.2.4 Connect piston rope to sediment depth-calibrated rope.

8.2.5 Lower the core tube into the water at least 2/3 the length of the core tube allowing water to enter the core tube before pulling the piston into the core tube.

8.2.6 Attach pole extension(s) to the core head and lower the core tube and pole extension(s) into the water. Continue to attach pole extensions as the core tube is lowered.

8.2.7 When the core tube hits the sediment surface, the calibrated depth rope fixed to the sample platform will pull the piston up through the core tube as the core tube is pushed into the sediment.

8.2.8 Continue to push the core tube into the sediment until point of refusal or the core tube has been fully inserted into the sediment.

8.2.9 Raise the core tube and remove pole extensions as the piston corer is brought to the sample platform.

8.2.10 Prior to bringing the core tube onto the deck of the sample platform, place a pre-cleaned core stopper on deck

8.2.11 Quickly raise the core tube onto the deck and set it down on top of the pre-cleaned core stopper.

8.2.12 Secure the core tube on the deck and drain the water above and below the piston by placing holes in the core tube.

8.2.13 Allow the water to drain, and remove the piston from the core tube.

8.2.14 The core is now ready to be processed by either extruding the sediment out of the

top of the core tube or dumping the sediment out of the bottom of the core tube.

8.2.15 Record the water depth, sediment core depth, station coordinates, and sample times onto appropriate data sheets.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the core tube, piston and core head in order to reduce the chance of contaminating the sediment sample.

10.0 DOCUMENTATION

Document the water depth, sediment core depth, basic sediment characteristics, station coordinates, sample time and processing time.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

STANDARD OPERATING PROCEDURE
SOP-BESI-303

TITLE: Collection of Finfish and Crabs Using Gill Nets

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

Collection of Finfish and Crabs Using Gill Nets

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to obtain finfish and shellfish specimens from shallow aquatic habitats using gill nets. This SOP describes the proper procedures for using gill nets to collect finfish and crabs from shallow aquatic habitat. Gill nets are usually used in shallow water near the shoreline, but may be used in deeper water if properly weighted and anchored. Gill nets with different mesh sizes can be used to target specific sized fish.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves and approved safety glasses should be worn when conducting this procedure in order to protect personal from possible contaminants that may be present in the water.

3.2 Proper lifting techniques should be utilized when handling heavy objects.

3.3 General boat safety criteria should be practiced at all times and includes awareness of other ship activities, wearing life jackets, monitoring marine radio, etc.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure and provide all the necessary information and data sheets to conduct the study. The task manager has responsibility for assuring that:

- All necessary equipment is available
- Health and safety precautions are taken
- Enough information has been provided to locate sample area and stations.

6.0 EQUIPMENT AND MATERIALS

- Monofilament gill nets
- Wooden poles (2x2)
- Inertia driver (for wooden poles)
- Concrete anchors
- Polypropylene or nylon rope (3/8-1/2 in diameter)
- Styrofoam floats
- Net picks
- Net tags
- Nitrile gloves
- Measuring board
- Re-sealable plastic bags
- Labels
- Permanent marker pens
- Ice chest with ice

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Gill nets can be purchased with many different mesh sizes and monofilament line strength. The size and strength of the primary target specie, or species will determine which mesh size and line strength should be used.

8.2 According to Texas law, gill netting is an illegal fishing method and may not be used unless persons using the nets are permitted by TPWD to use such methods. All gill nets must be tagged with the name of the user and the users TPWD permit number. Persons using gill nets must be in possession of a copy of the TPWD permit while the nets are in use.

8.3 Gill nets are used by vertically suspending the outstretched nets in areas where fish activity or traffic is heavy. Fish are caught in the nets as they attempt to swim through the mesh. Fish that are too large to pass through the mesh, will attempt to back out and will be snared by strands of the monofilament mesh under gills, scales, or spines.

8.4 Gill nets can be stretched across a fish pass or stream mouth, perpendicular to a shoreline, or parallel to a line of shoreline cover. Gill nets are set in an area used as a fish path or in an area that contains habitat utilized by the target fish species. Fish moving through or into the area may be caught in the net. A gill net is a passive fishing device and requires that the fish swim into it.

8.5 Gill nets are used by stretching the net across the area to be fished. An anchor should be attached to each end of the lead line of the net. Anchors hold the net down on the bottom and prevent it from being moved by water currents. Ends of the top line (float line) must be tied to structure (e.g., tree limbs, stumps, pilings) or a wooden stake driven into the bottom. For safety reasons, the stake should be visible above the waters surface.

8.6 Gill nets may be fished at any time the target fish are active, but they are generally most effective when set in the evening and fished through the night. Fish caught in the net will usually die quickly and should be removed from the net as soon as possible to prevent tissue deterioration. High water temperatures accelerate tissue deterioration.

8.7 A net is checked by raising it out of the water and removing captured fish from the mesh. Nets should be checked by starting at one end, and working toward the other end. Fish are removed from the net by hand; a net pick may be used to remove the fish. Nitrile gloves are worn to protect the hands of personnel and prevent contamination of the sample.

8.8 Gill nets are generally set and checked from the deck of a boat, but in water less than 3 ft, it may be more efficient to check the net by wading. If waders or hip-boots are worn, a personal flotation vest should be worn.

8.9 Fish removed from the nets should be placed in a fish basket or plastic tub until they are evaluated. Non-target species that are still alive must be returned to the water immediately.

8.10 Fish should be put in a labeled plastic bag and placed on ice in an insulated cooler.

8.11 Catch data should be recorded on data sheets.

9.0 QUALITY CONTROL CHECKS

Clean gloves will be worn at all times when handling the sampling equipment and samples.

10.0 DOCUMENTATION

General descriptive information of the sample site, catch, and field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of the sample area, bottom type, vegetation, and water depth,
- Location of the area sampled,
- List of species collected, and,
- Number and/or weight of organisms collected,
- Water temperature, salinity, and conductivity.

NOTE:

FOLLOW ONLY THE MOST RECENT ISSUE OF THIS SOP.

STANDARD OPERATING PROCEDURE
SOP-BESI-401

TITLE: YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

YSI 55 Handheld Dissolved Oxygen and Temperature Meter Calibration and Operation Procedures

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to calibrate and measure dissolved oxygen and temperature parameters.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when taking measurements in potentially contaminated water.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

Personnel conducting the procedure must have read and understood the owner's manual for the YSI 55 attached to this SOP.

6.0 EQUIPMENT AND MATERIALS

- 6 AA-size alkaline batteries
- Distilled water
- Nitrile gloves

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP and the attached YSI 55 owner's manual.

8.0 METHODS

8.1 Calibration

Before you calibrate the YSI Model 55, complete the procedures discussed in the Preparing the meter and preparing the Probe in the attached owners manual. The following procedure is taken from the YSI Model 55 owners manual.

To accurately calibrate the YSI Model 55, you will need to know the following information:

- The approximate altitude of the region of which you are located.
- The approximate salinity of the water you will be analyzing. Fresh water has a salinity of approximately zero. Seawater has a salinity of approximately 35 parts per thousands (ppt). If you are not sure about the salinity use the YSI 63 (SOP-BESI-402) to determine it.

8.1.1 Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.

8.1.2 Turn the instrument on by pressing the ON/OFF key on the front of the instrument. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required after turning the instrument on).

8.1.3 To enter the calibration menu, use two fingers to press and release both the UP ARROW and DOWN ARROW keys at the same time.

8.1.4 The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude. Example: entering 1 here = 100 feet.

8.1.5 When the proper altitude appears on the LCD, press the ENTER key. The Model 55 should now display CAL in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current DO reading (before calibration) should be on the main display.

8.1.6 Make sure that the DO reading (large display) is stable, then press the ENTER key. The LCD will prompt you to enter the approximate salinity of the water you are about to analyze. You can enter any number from 0 to 40 parts per thousand (ppt) of salinity. Use the arrow keys to increase or decrease the salinity setting. When the correct salinity appears on the LCD, press the ENTER key. The instrument will return to normal operation.

For best results:

- Each time the Model 55 is turned off, re-calibrate before taking measurements
- Calibrate at a temperature within ±10°C of the sample temperature.

8.2 Taking Readings

8.3.1 After the system has been set up, it is ready to take readings. Turn the instrument on and allow it to complete the self-test procedure.

8.3.2 Rinse the probe with distilled water.

8.3.3 Completely immerse the probe into the sample matrix.

8.3.4 You can move back and forth from reading dissolved oxygen in the mg/L mode or the % air saturation mode by pressing the MODE key.

8.3.5 After recording all your parameters for that sampling event, rinse the probe with distilled water.

9.0 QUALITY CONTROL CHECKS

Inspect the sample probe and meter prior to calibration and operation as designated in the owner's manual located in the Benchmark Ecological Services, Inc. library.

10.0 DOCUMENTATION

Record calibrations and readings on the appropriate data sheets and/or in designated notebooks.

STANDARD OPERATING PROCEDURE
SOP-BESI-402

TITLE: YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation Procedures

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

YSI 63 Handheld pH, Conductivity, Salinity and Temperature Meter Calibration and Operation Procedures

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to calibrate and measure for conductivity, salinity, temperature and pH using a YSI 63 handheld meter.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when conducting the calibrations and when taking measurements in potentially contaminated water.

3.2 Avoid inhalation, skin contact, eye contact or ingestion of pH buffer and conductivity solution.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is conducted.

5.0 RESPONSIBILITIES

Personnel conducting the procedure must have read and understood the owner's manual for the YSI 63 located in the Benchmark Ecological Services, Inc. library.

6.0 EQUIPMENT AND MATERIALS

- 6 AA-size alkaline batteries
- Plastic 100 mL graduated cylinder
- pH buffers 4, 7, 10
- Distilled water
- Conductivity standard solution(s)
- Nitrile gloves
- Clean glass beaker

7.0 TRAINING

Prior to conducting this SOP, responsible personnel (task manager and technicians) must read and understand this SOP and the YSI 63 owners manual located in the Benchmark Ecological Services, Inc. library.

8.0 METHODS

8.1 pH Calibration

The following procedures are taken from the YSI 63 meter owner's manual.

8.1.1 Turn the instrument on by pressing the ON/OFF key. Press the mode key until pH is displayed.

8.1.2 Rinse the probe with distilled water, then carefully dry the probe (or rinse it with some of the pH buffer solution to be used for calibration).

8.1.3 Place 30 to 35 mL of the pH buffer you have chosen to calibrate the system with (pH 7) in the 100 mL graduated cylinder. Immerse the probe making sure that both the pH & temperature sensors are covered by the solution.

8.1.4 To enter the calibration menu, use two fingers to press and release both the UP ARROW and DOWN ARROW keys at the same time. The display will show CAL at the bottom, STAND will be flashing and the pH reading will show 7.00.

8.1.5 Press the ENTER key. The display will show CAL at the bottom, STAND will stop flashing and the pH calibration value is shown with the middle decimal point flashing. Flashes until reading is stable.

8.1.6 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the calibration point. The model 63 will flash SAVE on the display along with OFS to indicate that the offset value has been saved.

8.1.7 SLOPE will now appear on the display and be flashing. This indicates that the slope is ready to be set using a second pH buffer. The system is now calibrated at a single point. If you are only performing a single point calibration, press the MODE key to return to normal.

8.1.8 Rinse the probe with distilled water.

8.1.9 If performing a 2-point or 3-point calibration, fill a clean container with the second value (pH 4) pH buffer and immerse the probe into the solution. Make sure the temperature sensor is immersed.

8.1.10 Press the ENTER key. The display should now show CAL at the bottom, SLOPE will stop flashing and the pH calibration value is shown with one of the decimal points flashing.

8.1.11 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the fist slope. The display will flash SAVE along with SLP to indicate that the fist slope value has been saved.

8.1.12 SLOPE will start flashing again indicating that the slope is ready to be set using the third buffer.

8.1.13 The system is now calibrated for 2-points. If you are only performing a 2-point calibration, press the MODE key to return to normal.

8.1.14 Rinse probe with distilled water.

8.1.15 If performing a 3-point calibration, fill clean container with the third buffer (pH 10) and immerse the probe into the buffer.

8.1.16 Press the ENTER key. The display will show CAL at the bottom, SLOPE will stop flashing and the pH calibration value is shown with one of the decimal points flashing. The right decimal point should be flashing.

8.1.17 When the reading is stable, the decimal point will stop flashing. Press and hold the ENTER key to save the second SLOPE. The display will flash SAVE along with SLP to indicate that the second slope has been saved.

8.1.18 The system will return to normal. Rinse the probe with distilled water.

8.2 Conductivity Calibration

The following procedure is taken from the YSI 63 meter owner's manual.

8.2.1 Turn the instrument on and allow it to complete the self-test procedure.

8.2.2 Select a calibration solution that is most similar to the sample you will be measuring.

- For sea water choose a 50 µS/cm conductivity standard
- For fresh water choose a 1 µS/cm conductivity standard
- For brackish water choose a 10 µS/cm conductivity standard

8.2.3 Place about 7 inches into a clean plastic container or glass beaker. Do not use

graduated cylinder.

8.2.4 Use the MODE key to advance the instrument to display conductivity.

8.2.5 Insert the probe into the solution deep enough to completely cover the probe. Both conductivity ports must be submerged.

8.2.6 Allow at least 60 seconds for the temperature reading to become stable.

8.2.7 Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.

8.2.8 Press and release the UP ARROW and DOWN ARROW keys at the same time. The CAL symbol will appear at the bottom left of the display to indicate that the instrument is in Calibration mode.

8.2.9 Use the UP ARROW and DOWN ARROW key to adjust the reading on the display until it matches the value of the calibration solution you are using.

8.2.10 Once the display reads the exact value of the calibration solution being used, press the ENTER key. The word SAVE will flash across the display for a second indicating that the calibration has been accepted. The instrument will hold that calibration until the next calibration. Therefore, there is no reason to recalibrate the instrument after changing the batteries.

8.3 Calibrating Salinity

8.3.1 Calibration is not an option for salinity, check to make sure the meter is reading correctly by completely immersing the probe in DI or Distilled water. The salinity reading should read zero.

8.4 Taking Readings

8.4.1 After the system has been calibrated, it is ready to take readings.

8.4.2 Rinse the probe with distilled water.

8.4.3 Completely immerse the probe into the sample matrix.

8.4.4 Shake the probe to dislodge any air bubbles from the probe.

8.4.5 Use the MODE key to scroll through the parameters to record your readings.

8.4.6 After recording all your parameters for that sampling event, rinse the probe with distilled water.

9.0 QUALITY CONTROL CHECKS

Inspect the sample probe and meter prior to calibration and operation as designated in the attached owners manual.

10.0 DOCUMENTATION

Record calibrations and readings on the appropriate data sheets and/or in designated notebooks.

STANDARD OPERATING PROCEDURE
SOP-BESI-403

TITLE: Locating and Recording Sample Stations Using a Trimble GEO XT Global Positioning System

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

Station Positioning Using Global Positioning System

1.0 PURPOSE AND APPLICABILITY

This SOP covers the procedures for locating and recording the sampling stations and/or sites using a Trimble GEO XT Global Positioning System (GPS).

2.0 DEFINITIONS

Global Positioning Systems (GPS) are multi-functional navigation systems that use satellites to calculate latitude and longitude. By computing the distance between three or more satellites and the ground receiver, the GPS system generates an accurate current location. When a sample station/site is selected, the GPS will aid in navigation to the exact latitude and longitude position.

3.0 HEALTH AND SAFETY CONSIDERATIONS

Do not us a GPS unit as the sole method of navigation.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All personnel use this procedure to locate and record sampling stations and/or sites.

6.0 EQUIPMENT AND MATERIALS

- GPS (fully charged or external power source)

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 In order to navigate to a station, follow the procedures outlined in Tutorial Section of the TerraSync operation guide stored at the Benchmark Ecological Services, Inc. Library.

8.2 When recording a sample station, follow the procedures outlined in Tutorial Section of the TerraSync operation guide stored at the Benchmark Ecological Services, Inc. Library.

9.0 QUALITY CONTROL CHECKS

No quality control checks are necessary for locating and recording the sampling stations and/or sites using a Trimble GEO XT Global Positioning System (GPS).

10.0 DOCUMENTATION

See electronic copy of documents: Geo_300_GSG_46506-30-ENG.pdf, PathFinderOffice280_Vol3B_Eng.pdf, and TerraSync operations manual.pdf

STANDARD OPERATING PROCEDURE
SOP-BESI-502

TITLE: Sample Shipping and Freezing Procedures

The attached Standard Operating Procedure was revised by:

Neil Heathorne		3-1-06
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

William Quast		3-1-06
Name	**Signature**	**Date**

Revision No. 2

Sample Shipping and Freezing Procedures

1.0 PURPOSE AND APPLICABILITY

To ensure that samples are properly stabilized prior to shipment.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must be also available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- Prior to sample collection, the laboratory conducting analyses should be contacted by the Study Director, Project Manager, Field Crew Leader, or a designee to verify that the laboratory is prepared to accept the samples.

6.0 EQUIPMENT AND MATERIALS

- Cooler, freezer, or refrigerator
- Ice for cooler
- COC's
- Pen
- Sharpie

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Preparation of Samples Prior to Shipment:

8.1.1 In the field, samples shall be stored on ice.

8.1.2 Depending on the desired sample analysis, the sediment, tissue and water samples shall be either placed in freezers or coolers containing ice, or placed inside a refrigerator set at 4°C, until sample shipment occurs.

8.1.3 Fill out chain of custody (COC) form according to project SAP. Put COC form in plastic bag and tape to the inside top or lid of the sample shipment cooler, or placed with sample containers in their storage area.

8.1.4 If in an environment where people other than project staff can access samples, seal the freezer or cooler with a chain-of-custody label or lock to protect against tampering.

8.2 Shipping Instructions:

8.2.1 All samples are to be a hand delivered or shipped via overnight courier to the laboratory.

8.2.2 If water, tissue, or sediment samples are held for over 24-hours they should generally be kept on ice, or at a minimum, refrigerated prior to shipment. Check the project Sampling and Analysis for project-specific requirements.

9.0 QUALITY CONTROL CHECKS

There are no specific Quality Control Checks for this SOP

10.0 DOCUMENTATION

There are no specific Quality Control Checks for this SOP

STANDARD OPERATING PROCEDURE
SOP-BESI-503

TITLE: Compositing Sediment Samples

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

1.0 PURPOSE AND APPLICABILITY

The purpose of this standard operating procedure is to ensure that proper mixing of sediment samples occurs when compositing is required. This standard operating procedure describes the procedures for compositing sediment samples. After the samples are composited, they are split into different containers.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn when performing this procedure.

3.3 If volatile chemicals are expected in samples, respirators (with proper cartridge) must be worn.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile Gloves
- Stainless steel bowls
- Stainless steel spoons (Large and Small)
- Clean, labeled sample jars
- Clean, labeled VOCs jars

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Prior to splitting samples for analytical testing, representative samples must be taken for analysis of VOCs and semi VOCs.

8.1.1 Use a small stainless steel spoon to take sediment samples that collectively represent the sample.

8.1.2 Take representative samples until the VOC jar is filled.

8.1.3 Cap or close the container and handle according to SOP-BESI-502.

Note: You are dealing with volatile gases, therefore this must be completed in a timely manner.

8.2 The sediment must be homogenized in a thorough manner. Compositing is necessary when

samples are collected.

8.2.1.1 Thoroughly mix the sediments together with a large clean stainless steel utensil.

8.2.1.2 Mixing should occur for approximately 3-5 minutes per sample. To ensure the best possible results, mixing should be conducted in various clockwise, counterclockwise and chopping motions with emphasis being placed on folding the sediment from the outer edges of the container to the center.

8.2.1.3 After the sediment is homogenized, collect sub-samples from the sample and place them into the container until completely filled.

8.2.1.4 Cap or close the containers and handle according to SOP-BESI-502.

9.0 QUALITY CONTROL CHECKS

Gloves should be worn at all times while handling the sample.

10.0 DOCUMENTATION

General descriptive information on the sediments and appropriate field data should be entered in the field data log (SOP-BESI). Observations may include the following:

- Characteristics of sample, including texture, color, biological structures (e.g., shells, benthic infauna), debris (wood chips, human artifacts), odors (oil, gas, hydrogen sulfide),
- Approximate depth or aerobic and anaerobic sediment layers.

STANDARD OPERATING PROCEDURE
SOP-BESI-506

TITLE: Measuring Crab Carapace Width and Wet Weight

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

MEASURING CRAB CARAPACE WIDTH AND WET WEIGHT

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for measuring crab carapace width and wet weight prior to tissue processing for chemical analysis.

2.0 DEFINITIONS

Carapace - Large shell that forms protective covering on most crabs.
Carapace width - Lateral distance across the carapace from tip of spine to tip of spine.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 MATERIALS

- Measuring Board
- Electronic balance
- Labels
- Marking pens
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Sample Preparation

Prior to handling any crab samples, all staff must wear nitrile gloves and all table surfaces should be scrubbed with a cleanser and covered with solvent rinsed aluminum foil. Next, remove the crab from the sample containers or bags and wipe clean of all external debris (e.g., sand, plant material, etc.) using a Kimwipe or other clean paper product. The following sections describe the specific procedures to be followed for measuring and weighing the crab.

8.2 Crab Carapace Width Measurement

1. Place the crab on a fish measuring board that it is upright exposing the carapace.
2. Measure and record the distance in millimeters across the carapace from tip of spine to tip of spine.

8.3 Crab Wet Weight

Note -These procedures assume the top loading balance has already been properly calibrated according to its respective SOP.

1. Place a piece of clean aluminum foil onto the weighing plate of a top loading balance and tare the balance to read, "zero".
2. Next, remove any excess water from the crab shell by patting dry with a Kimwipe.
3. Place the crab on the tared scale making sure that the entire organism is on the aluminum foil.
4. Record the weight of the crab in grams to the appropriate significant digit {balance dependant) on the data log forms.
5. Discard the aluminum foil after each separate crab sample is weighed, and, if necessary, remove the weighing plate from the top loading balance and wash with soap (Alconox) and warm water, followed by deionized water.

9.0 QUALITY CONTROL CHECKS

Ensure that the top loading balance has been accurately calibrated.

10.0 DOCUMENTATION

Detailed records should be kept to document routine calibration of the balance prior to each use as well as routine servicing by qualified technicians.

STANDARD OPERATING PROCEDURE
SOP-BESI-507

TITLE: Crab Tissue Processing

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

CRAB TISSUE PROCESSING

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for laboratory preparation of edible crab tissue samples for analysis.

2.0 DEFINITIONS

Carapace – Large shell that forms protective covering on most crabs.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn while using methanol, hexane, or 5 percent nitric acid.

3.3 Use of methanol or hexane should be under a fume hood.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Scalpels
- Top loading balance (0.1 gm)
- Stainless Steel Crackers
- Sample Container
- Freezer (chest or upright)
- Spatulas -stainless steel or Teflon coated
- Decontamination materials: DI water, soap, ultra-pure hexane, or methanol
- Labels
- Marking pens
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Unwrap and thoroughly rinse each crab with DI water to remove any gross field contaminants. Measure and weigh each crab according to SOP-BESI-506.

8.2 Claw Tissue Removal Procedure

Remove both claws from the body by breaking the joint between the basal segment (attached to the body) and the first leg segment. This will prevent the loss of muscle tissue from inside the body.

Crush the terminal segment of each claw (largest segment) with stainless steel claw cracker. Be careful not to crush the muscle tissue inside the claw. With gloved hands, remove the muscle with a spatula or scissors. Place the tissue directly into a sample container. The sample container should be on the balance and tared prior to processing the crab.

8.3 Body Tissue Removal Procedure

The first step is to remove the shell by flipping the crab over on the table or in the palm of the hand and locating the point where the rear of the carapace meets the underside of the crab. The crab's tail should be seen folding towards the front of the shell (will be narrow and pointed in males and wide and round in females). Grasp the end of the tail and pull towards the rear of the crab. Once the tail is lifted, a small gap should appear providing a finger hold for grasping the rear of the carapace and tearing it from the rest of the crab's body. Removal of the upper carapace will expose the gills (white spongy tissue at the perimeter of the body}, and the digestive gland (yellow to brown tissue in the center of the body) .The gills and digestive gland should be removed by scraping with a spatula or scalpel. The remaining body half should be rinsed with deionized water. After the gills and digestive gland are removed, a series of muscle filled chambers (separated by thin shell) will be seen on both sides of the body. Remove the shell covering the chambers with the scissors and scrape out the muscle tissue with a spatula or scalpel. Place the tissue in the sample jar on the balance along with the claw muscle. Record the weight of all the tissue removed from the crab.

8.4 Decontamination Procedures

Decontamination of the equipment used should follow this general sequence:

1. Rinse with tap water and brush away large pieces of tissue.
2. Clean apparatus with soapy water and brush.
3. Rinse soap away first with tap water and then with DI water.
4. Rinse thoroughly with ultra-pure hexane or methanol (for organics; or 5% nitric).
5. Finally, triple rinse with DI water.

8.5 Equipment Storage

After use of all equipment thoroughly decontaminate and wrap or cover all items with clean hexane-rinsed aluminum foil. Store equipment in an appropriate location.

8.6 Sample Handling and Shipment

Store samples in secure cold storage. Ship frozen samples in coolers to the analytical laboratory via overnight carrier.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for crab tissue processing may consist of rinsate blanks to ensure the processing equipment (i.e., scissors) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Next, the equipment will be either soaked or rinsed with deionized water and collected for chemical analysis.

10.0 DOCUMENTATION

When sending tissue samples to the analytical laboratory, follow the appropriate SOP for chain-of-custody and shipping documentation requirements. Indicate in laboratory logbook that samples have been prepared and sent to the analytical laboratory for analysis. Sign and date all chart forms and logbook pages, as appropriate.

STANDARD OPERATING PROCEDURE
SOP-BESI-508

TITLE: Measuring Fish Length and Wet Weight

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

FISH LENGTH AND WEIGHT PROCEDURES

1.0 PURPOSE AND APPLICABILITY

The purpose of this procedure is to accurately measure the length and weight of fish prior to tissue processing and chemical analyses. Whole fish samples will be collected in the field for chemical analysis. As soon as possible after collection, and prior to tissue removal and processing, accurate measurements of fish length and weight should be recorded. If possible, these measurements should occur on the sample vessel immediately after collection to prevent weight changes resulting from fluid loss after the organisms die.

2.0 DEFINITIONS

Caudal Fin - posterior-most unpaired fin (i.e., tail).

Total Length - length from anterior-most point of nose to the tip of the longest caudal fin ray when the lobes of the caudal fin are compressed dorsoventrally.

Standard Length - length from the anterior-tip of the nose to the posterior tip of the hypural plate.

Fork Length - length from the anterior-most point of the nose to the notch in the tail fin of fork-tailed fishes.

3.0 HEAL TH AND SAFETY CONSIDERATIONS

No specific health and safety considerations are necessary other than the general procedures outlined in the health and safety plan.

4.0 QUALITY ASSURANCE PLANNING CONSIDERA TIONS

No study-specific variances from this sap are anticipated.

5.0 RESPONSIBILITIES

It is the field study manager's responsibility to ensure that all field staff is familiar with this SOP.

6.0 TRAINING/QUALIFICA TIONS

No special training or qualifications other than knowledge of this sap are needed to accurately measure and weigh fish.

7.0 REQUIRED MATERIALS

The following materials are necessary for this procedure:

- Deionized water
- Electronic balance
- Measuring board
- Data log forms
- Decontamination materials
- Aluminum foil.

8.0 METHODS

8.1 Sample Preparation

Prior to handling any fish samples, all staff must wear powder-free latex gloves and all table surfaces should be scrubbed with a cleanser and covered with solvent rinsed aluminum foil. Next, remove the fish from the sample containers or bags and wipe clean of all external debris (e.g., sand, plant material, etc.) using a Kimwipe or other clean paper product. The following sections describe the specific procedures to be followed for measuring and weighing the fish.

8.2 Fish Measurement

1. Place the fish on the measuring board on its side so that the tip of its nose (anterior) is touching the stop plate at the beginning of the tape measure.
2. Slide the measuring scale to the point on the fish corresponding to the desired measurement (i.e., total length, fork length, standard length) and record the value on the data log forms.

8.3 Fish Wet Weight

Note -These procedures assume the top loading balance has already been properly calibrated according to its respective SOP.

1. Place the fish on the tared scale and record the weight of the fish to the appropriate significant digit (balance dependant) on the data log forms.
2. Clean and tare scale prior weighing the next sample.

9.0 QUALITY CONTROL CHECKS AND ACCEPTANCE CRITERIA

Ensure that the top loading balance has been accurately calibrated.

10.0 DOCUMENTATION

Detailed records should be kept to document routine calibration of the balance prior to each use as well as routine servicing by qualified technicians.

STANDARD OPERATING PROCEDURE
SOP-BESI-509

TITLE: Fish Tissue Processing

The attached Standard Operating Procedure was revised by:

Katy Garcia		09/14/05
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

David Marhofer		09/14/05
Name	**Signature**	**Date**

Revision No. 1

FISH TISSUE PROCESSING

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for laboratory preparation of edible fish tissue samples for analysis.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Safety glasses should be worn while filleting tissue and while using hexane.

3.3 Use of hexane should be under a fume hood or in a well ventilated area.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Fish scaler
- Aluminum foil
- Electric fillet knife, fillet knife
- Stainless steel fillet blades
- Cutting board
- Top loading balance (0.01 gm)
- Cooler (chest or upright)
- Decontamination materials: DI water, soap, ultra-pure hexane
- Labels
- Marking pens
- Freezer grade Zip Loc
- Finfish processing forms
- Chain-of-Custody forms

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Unwrap and thoroughly rinse each fish with DI water to remove any gross field contaminants. Measure, weigh, and label each fish according to appropriate SOP (SOP-BESI-508).

8.2 Fish Scale Removal Procedure

Remove fish scales from fish so as scales will not be processed into the edible tissue sample. Wear nitrile gloves and safety glasses when scaling fish. Once the fish has been scaled, rinse the fish with DI water, and store on ice until the sample can be filleted.

8.3 Body Tissue Removal Procedure

Fillet the fish with your choice of pre-cleaned utensils (electric fillet knife, regular fillet knife). Sample fillet should represent the edible portion of each fish. Record the weight of the tissue removed from each fish. Double-wrap the tissue in aluminum foil that has been pre-rinsed in hexane, double-bag the foil wrapped tissue in labeled re-sealable Ziploc bags, and place in secure cold storage.

8.4 Decontamination Procedures

Decontamination of the equipment used should follow this general sequence:

1. Rinse with tap water and brush away large pieces of tissue.
2. Clean apparatus with soapy water and brush.
3. Rinse soap away first with tap water and then with Dl water.
4. Rinse thoroughly with ultra-pure hexane.
5. Finally, triple rinse with DI water.

8.5 Equipment Storage

After use of all equipment thoroughly decontaminate and wrap or cover all items with clean hexane-rinsed aluminum foil. Store equipment in an appropriate location.

8.6 Sample Handling and Shipment

Store samples in secure cold storage until shipment. Ship samples in coolers to the analytical laboratory via overnight carrier.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for fish tissue processing may consist of rinsate blanks to ensure the processing equipment (i.e., fillet knives) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Next, the equipment will be either soaked or rinsed with deionized water and collected for chemical analysis.

10.0 DOCUMENTATION

When sending tissue samples to the analytical laboratory, follow the appropriate SOP for chain-of-custody and shipping documentation requirements. Indicate in laboratory logbook that samples have been prepared and sent to the analytical laboratory for analysis. Sign and date all chart forms and logbook pages, as appropriate.

STANDARD OPERATING PROCEDURE
SOP-BESI-600

TITLE: Water Sampling via Peristaltic Pump

The attached Standard Operating Procedure was revised by:

Neil Heathcote		3-1-06
Name	**Signature**	**Date**

The attached Standard Operating Procedure was reviewed by:

Bill Quast		3-1-06
Name	**Signature**	**Date**

Revision No. 2

Water Sampling via Peristaltic Pump

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for conducting water sampling via peristaltic pump.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Peristaltic pump
- C-Flex^{R} tubing
- Cable ties
- Filter
- 12 Volt battery
- Boat
- Pre cleaned sample bottles

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

All tubing and filters should be pre-cleaned prior to sampling using the cleaning procedures described in SOP-BESI-601. The pump may be used to circulate the cleaning solutions and rinsate through the tubing.

8.2 Set Up Procedures

Set up the peristaltic pump by attaching the peristaltic pump to the battery. Insert a predetermined length of C-Flex^{R} tubing into the pump head and secure the pump head with the adjustment knob. The length of the C-Flex^{R} tubing will be determined by the depth at which the water sample will be collected. If required connect a filter downstream of the peristaltic pump. Filter requirements and sizes will be listed in the SAP.

8.3 Tube Purging Procedures

After lowering the intake end of the tubing to the desired collection depth, purge the system for a minimum of one minute by pumping site water through the tubing. The purge time may be increased depending on the depth of sampling and the length of the tubing. If analytes require filtration the filter should be connected to the tubing before purging. Project Manager should designate the purge time prior to field collection.

8.4 Sampling Procedures

Filtered samples are collected directly into pre-cleaned bottles, sealed and placed on ice for shipment to the laboratory for analysis. Unfiltered samples will be collected after the filter is removed from the tubing. Unfiltered samples will be collected into pre-cleaned bottles, sealed and placed on ice for shipment to the laboratory for analysis.

8.5 Labeling Procedures

The sample containers will be labeled according to project requirements. Chain of Custody forms will be completed immediately after sample collection.

8.6 Sample Storage for Shipment

The water sample is then placed in a resealable Ziploc^{R} bag and placed in the sample holding container on ice according to SOP-BESI-502.

8.7 In-situ Measurement Procedures

In-situ measurements will be taken at the time of sample collection using a YSI 55 Meter and a YSI 63 Meter, in accordance with SOP-BESI-401 and SOP-BESI-402, respectively.

8.8 Field Data Recording Procedures

General descriptive information and the appropriate field data should be entered onto the field data log.

9.0 QUALITY CONTROL CHECKS

Quality control checks required for water sampling via peristaltic pump may consist of rinsate blanks to ensure the processing equipment (i.e., tubing and filters) are free of chemical contamination. If required, rinsate blanks shall be collected by first decontaminating the equipment using the appropriate procedure for the analyses being conducted. Deionized water (DI water) will be pumped through the tubing and filter(s) to be used during the field collection. The DI water will be collected in appropriate sample containers and placed on ice for shipment to the laboratory for analysis.

10.0 DOCUMENTATION

When sending water samples to the analytical laboratory, follow the appropriate chain-of-custody and shipping documentation requirements.

STANDARD OPERATING PROCEDURE
SOP-BESI-601

TITLE: Decontamination of Tubing and Filters for Water Sampling

The attached Standard Operating Procedure was revised by:

Name	Signature	Date
Neil Hawthorne	Neil Hawthorne	3-1-06

The attached Standard Operating Procedure was reviewed by:

Name	Signature	Date
William Quast	William Quast	3-1-06

Revision No. 2

Decontamination of Tubing and Filters for Water Sampling

1.0 PURPOSE AND APPLICABILITY

This procedure provides the basic methodologies for conducting decontaminating tubing and filters used in water sampling studies.

2.0 DEFINITIONS

There are no definitions applicable for this SOP.

3.0 HEALTH AND SAFETY CONSIDERATIONS

3.1 Nitrile gloves should be worn when performing this procedure.

3.2 Work under an air hood or in a well ventilated room when working with HCL.

4.0 QUALITY ASSURANCE CONSIDERATIONS

This SOP must not be implemented until trained personnel are available to conduct this procedure. All necessary equipment, space, containers, and documentation materials must also be available before this procedure is performed.

5.0 RESPONSIBILITIES

The project manager must assign a task manager to conduct this procedure. The task manager has responsibility for assuring that:

- All necessary equipment is available; and
- All samples are prepared according to this procedure.

6.0 EQUIPMENT AND MATERIALS

- Nitrile gloves
- Peristaltic pump
- C-Flex^R tubing
- Cable ties
- Filter(s)
- 12 Volt battery
- 10 % HCL Solution
- Deionized Water

7.0 TRAINING

Prior to performing this SOP, responsible personnel (task manager and technicians) must read and understand this SOP.

8.0 METHODS

8.1 Pre-Preparation

Mix a 10% HCL Solution with Laboratory Grade HCL and Deionized (DI) Water.

8.2 Set Up Procedures

Set up the peristaltic pump by attaching the peristaltic pump to the battery. Insert C-Flex^R tubing into the pump head and secure the pump head with the adjustment knob. The length of the C-Flex^R tubing will be determined by the project or may be pre-cut for specific sample stations. If required for the field study, connect filter(s) downstream of the peristaltic pump. Filter requirements and filter sizes will be determined by the analyte list and the analytical methods.

8.3 Tube and Filter Cleaning

Pump 10% HCL solution through the tubing and filter(s) for five minutes. Clear the tubing and purge the tubing and filter(s) with DI Water for 5 minutes.

8.4 Packaging Clean Tubing and Filter(s)

If tubing has not been cut for specific sample stations then cut tubing to desired length for each of the sample stations. Once the tubing has been cut and clean filters (if needed) are properly connected, place the tubing ends inside a clean Ziploc bag. In most cases the entire length of tubing will not fit inside a Ziploc, use a cable tie to seal the Ziploc bags around the tubing ends. Place the tubing and filter(s) inside of two clean kitchen bags.

8.5 Labeling Procedures

Label the outside of sealed kitchen bags with your initials, date, and sample station.

9.0 QUALITY CONTROL CHECKS

Do not use tubing or filters that have been exposed to potential contamination sources. Inspect tubing prior to sampling

10.0 DOCUMENTATION

Document decontamination date and personnel on field mobilization sheets.

Appendix F

EA Team Standard Operating Procedures

1.3 Field Log Book

The following SOG describes the appropriate guidelines for note taking during field activities.

These SOPs and SOGs shall be reviewed periodically, and revisions and additions to these SOPs and SOGs shall be made as needed to assure consistency with industry standards and the collection of high quality data in the field. Requests for revisions shall be made in writing to the President or his/her quality assurance designee.

The field log book is an integral part of the sampling program and forms the basis of the sampling record. A complete field log book is required on most projects. Items documented in the log book are highly relevant to interpreting the subsequent collected data. The objective of taking field notes is to make an accurate written record of the field activities. The field log book serves as a method to record additional site information and observations not easily included on field forms. Field notes often serve as the basis for writing a report after the work is complete. Field notes should be sufficiently accurate and complete that the events that took place can be recreated by someone who was not involved in the activities.

1.3.1 Equipment

- Field log book: water-resistant paper, permanently bound, with sequentially-numbered pages
- Waterproof pens (blue is sometimes preferred to differentiate originals from copies)

1.3.2 General Guidelines

- Make all entries using waterproof pen
- **Write legibly**. If you abbreviate, be sure to define your abbreviation somewhere in the notes.
- Be as brief as clarity will allow. However, it is better to record too much data than to try and recreate activities from memory.
- Be accurate. If you have to guess, identify your entry as a guess.
- Be detailed and quantify your data as much as possible. When in doubt measure.
- Sketches and drawings add depth and detail to your notes.
- Do not scribble through entries you want to change. To make a correction, draw a single line through the entry and date the correction.
- Do not remove pages from the log book. Remember that the field log book can become a legal document.

1.3.3 Requirements

- Each day's log should begin at the top of a page
- At the top of each page, include:

  - A header that identifies the project name and location
  - The date
  - The name and initials of the person taking notes

- The first entry of the day should identify the location, names of Team personnel, visitors, contractors, etc., and the purpose of the activities (e.g., well installation, development, sampling, etc.).
- Each important observation should start with the time (i.e., when)
- The person taking notes should sign and date each page.
- A diagonal line should be drawn across the bottom of each day's entry, then signed and dated.
- For litigation projects, each person should have their own field log book and keep notes as necessary. If only one log book is used, try to have one person do all the note-taking. If the log book is used by more than one person, each person taking notes should sign at the end of their entry before transferring the log book to another person.
- The log book should stay in the custody of the note taker.
- Do not recopy your field notes. Field notes are notes taken in the field. Remember, a few days (or weeks) later, what you think you saw may not actually be what you did see. Field notes can become a legal document so think of them that way from the start.
- Review your notes at least daily for cryptic entries that need additional explanation.

Examples of Noteworthy Items

- Time of arrival and departure
- Attendees at tailgate safety meetings
- Arrival and departure of visitors
- Contents and conclusions of key phone calls and meetings
- Important instructions to staff and contractors (especially if it leads to standby time charges)
- Weather and changes in weather
- Name, type, and condition of equipment being used
- Procedures and results of instrument calibrations
- Changes in activities (e.g., move to decon pad to clean drill rig)

- Down time and cause (e.g., repair drive line on rig)
- Document and explain field decisions (e.g., why you decide not to tremie grout)
- Important results
  - Field parameters collected during well development or sampling
  - Sample IDs and time of collection
  - Sample containers, volumes, and preservation
- Observations
  - General soil type
  - Hard drilling conditions
  - Soil staining or odor
  - Condition of tanks and associated piping
- Health and Safety
  - Document tailgate meetings
  - Document results of utility clearances
  - Site inspections (e.g., condition of excavation)
  - Health and/or safety violations and warnings
  - Results of air or other monitoring (e.g., PID readings)

Appendix G

Field Quality Control Sample Requirements, As Prescribed in PRP QAPP (March 2006)

TABLE A-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: SOIL

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[(1)]	Matrix Spikes/ Matrix Spike Duplicates[(1)]
Metals	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE B-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: GROUNDWATER

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[1]	Matrix Spikes/ Matrix Spike Duplicates[1]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Metals	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[2]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE C-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: SURFACE WATER

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[(1)]	Matrix Spikes/ Matrix Spike Duplicates[(1)]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Metals (total)	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Metals (dissolved)	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE D-3 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: SEDIMENT

Laboratory Parameters	Trip Blanks	Equipment/ Field Blanks	Field Duplicates[(1)]	Matrix Spikes/ Matrix Spike Duplicates[(1)]
Chromium VI	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Metals	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Mercury	NA	1 per day	1 per 20 samples	1 per 20 samples[(2)]
Organochlorine Pesticides	NA	1 per day	1 per 20 samples	1 per 20 samples
PCBs	NA	1 per day	1 per 20 samples	1 per 20 samples
VOCs	1 per cooler	1 per day	1 per 20 samples	1 per 20 samples
SVOCs	NA	1 per day	1 per 20 samples	1 per 20 samples

Notes:
1. Frequency is one per twenty samples or one per day, whichever is greater.
2. An analytical duplicate (i.e., unspiked) may be substituted for the matrix spike duplicate.

TABLE E-4 - FIELD QUALITY CONTROL SAMPLE REQUIREMENTS

MEDIA: FISH TISSUE

Laboratory Parameters	Trip Blanks	Equipment/Field Blanks	Field Duplicates
TBD[1]	TBD	NA[2]	1 per species

Notes:
1. TBD = To be determined; laboratory parameters will be determined following analysis and review of Intracoastal Waterway sediments, as detailed in the RI/FS Work Plan.
2. NA = Not applicable for the sampling techniques.